SIGNAL

FEBRUARY 1961

FROM OUT OF THE BLUE
FROM
POLE TO POLE

POLARIS

The industry's broadest line of

COMMUNICATIONS TRANSISTORS

You'll find one Exactly Right for your requirements

■ Whatever your specific requirements . . . in gain, noise figure, AGC and other electrical characteristics . . . you'll find a Philco communications transistor that meets your needs precisely.

Unlike other manufacturers, who offer only limited lines of "general-purpose" transistors, Philco designs and produces transistors to meet specific requirements. Philco can do this only because the exclusive Philco Precision-Etch* process of manufacture permits precise control of all parameters and absolute uniformity.

To increase circuit efficiency and reliability, to reduce cost and to make your design easier . . . look first to the Philco line, which offers you the industry's widest range of communications transistors. You'll find one *exactly right* for your requirements.

*Trademark Philco Corp.

NEW! Transistor Guide

for Communications Circuit Designers

To make it faster and easier for you to find the Philco communications transistor that best meets your needs, put this new guide to work for you. 12 pages of application information, descriptions of major types and a complete selector chart will speed your work. For your copy, write Dept. S261.

Philco Transistors are immediately available in quantities 1-999 from your Philco Industrial Semiconductor Distributor.

PHILCO®

Famous for Quality the World Over

LANSDALE DIVISION • LANSDALE, PENNSYLVANIA

TRANSISTOR CENTER U.S.A.

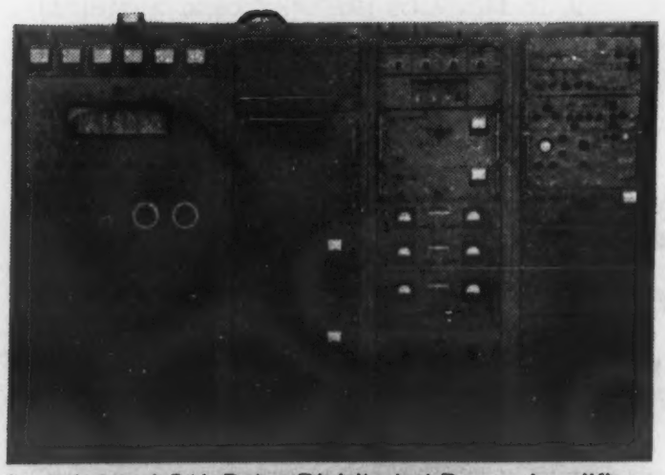
Granger Associates fast-stepping ionosphere sounder

Backscatter or synchronized oblique sounding.

4-64MC IN 3.2 SECONDS

for rapid, precise measurement of ionosphere parameters on a continuous basis.

Typical oscilloscope record shows vertical incidence and backscatter returns using G/A Model 902



Sounder and G/A Pulse Distributed. Power Amplifier.

The G/A 902 step-frequency ionosphere sounder is a multi-channel electronically-stepped high-power transmitter/receiver operating in the h-f band. 160 frequencies, from 4 to 64 megacycles, are derived from a single stable reference, and are electronically selected at rates up to 50 frequency changes per second. Operation is entirely electronic—there are no mechanical switches or tuning devices. Associated power amplifiers are available with pulse power outputs up to 100 kw.

Research Applications: Because of its simultaneous time and frequency resolution capabilities, this sounder is especially suited for observing auroral ionization, artificial ion clouds and ionized meteor trails. Other research applications include the observation of traveling disturbances at either oblique or vertical incidence.

Communications Applications: This sounder can be used with a steerable or fixed antenna to provide a continuous and essentially instantaneous display of the coverage area for one-hop ionospheric transmission. Two-hop and even higher order modes are displayed a substantial portion of the time.

For direct measurement of path loss, two or more sounders can be synchronized to provide an instantaneous display of path loss and/or path delay vs. frequency between circuit terminals.

A thirty-five page Granger Associates report gives you full specifications and operating principles on the sounder and related information on antenna systems. We'll be happy to send you a copy —airmail.

Send For Complete Information

GRANGER ASSOCIATES / 974 Commercial Street / Palo Alto, California / DAvenport 1-4175

IRE 1961

COMPUTER ISSUE

SPECIAL JANUARY ISSUE

Proceedings of the IRE

Electronic computers are the "time machines" of today — they bring to man the precious gift of time. They think, relate, evaluate and solve fantastic problems in millionths of a second. Each operation they perform releases you, the radio-electronics engineer, the mathematician, the physicist, the chemist — for work that calls for the human mind and heart.

Obviously, you should know about computers. Computers, today, are more compact, more complex, and about 50,000 times faster than those made just a few years ago. Progress such as this means constant and dramatic changes. It would take precious hours each day to keep abreast of all developments.

You can, however, learn about computers far more easily — by reserving your copy now, of this special January issue of **Proceedings.** In it you will find the sum of all that's new in computers. You get 360 pages of brilliant research and authoritative writing (of course at engineering levels), made up of some 40 separate papers; 12 of these specially-invited.

Like other special issues of **Proceedings,** the computer issue promises to remain definitive for years to come. If you're not already an IRE member, make sure you get a copy of the **Proceedings** Special Computer Issue by sending in the coupon below.

INVITED PAPERS FOR COMPUTER ISSUE INCLUDE:

Adaptive Control — Present and Future
J. G. Truxall (Poly. Inst. of Brooklyn)
State of the Art of Perceptron Machines
J. R. Hawkins (Aeronutronic Systems)
Survey of Artificial Intelligence Marion Minsky (MIT Lincoln Lab.)
Organization of Arithmetic and Control Sections of Computers
W. L. Lawless, Jr. (IBM)
Survey of Storage Devices Jan Rajchman (RCA)
Automatic Programming
W. Orchard-Hays (Corp. for Economic Industrial Research)
State of the Art of Digital Communication
J. M. Wier (Bell Telephone Labs.)
Computer Developments in Europe
Isaac Auerbach (Auerbach Electronics)
New Applications of Computers W. F. Bauer (Ramo-Wooldridge)
State of the Art of Display Equipment
Roger Sisson (Aeronutronic Systems)

REMEMBERS THE MAN

Proceedings of the IRE
1 East 79th St., New York 21

☐ Enclosed is $3.00
☐ Enclosed is company purchase order for the January, 1961, issue on Computers 1961.

All IRE members will receive this January issue as usual.
Extra copies to members, $1.25 each (only one to a member).

Name_____

Company_____

Address_____

City & State_____

THE INSTITUTE OF RADIO ENGINEERS
1 East 79th Street, New York 21, New York

1624 Eye Street, NW
Washington 6, D. C.
Phone: EXecutive 3-3033

Editor
W. J. BAIRD

Advisory Editor
ROLAND C. DAVIES

Managing Editor
JUDITH H. SHREVE

Associate Editors
CHARLES DeVORE
GEORGE C. RUEHL, Jr.
DR. HAROLD A. ZAHL
EDWARD K. KAPRELIAN

Editorial Assistants
R. A. GALLAGHER
S. E. HOOD
J. M. BARNETT

Contributing Editors
T. E. GOOTÉE

Army
LT. COL. KENNETH E. SHIFLET, SigC.

Navy
CAPTAIN ROBERT H. WEEKS, USN

Air Force
COLONEL JOHN E. MORRISON, USAF

Authors are entirely responsible for opinions expressed in articles appearing in AFCEA publications, and these opinions are not to be construed as official or reflecting the views of the Armed Forces Communications and Electronics Association.

SIGNAL is published monthly by the Armed Forces Communications and Electronics Association at 1624 Eye St., N. W., Washington 6, D. C. Second class postage paid at Washington, D. C., and at additional mailing offices.

Subscription rate to members of the AFCEA: 1 year (12 issues), $5.00. To non-members, $7.00. To foreign post offices, $8.00. Single copies, $1.00 each. All rights reserved. Copyright 1961 by Armed Forces Communications and Electronics Association. Reproduction in whole or in part prohibited except by permission of the publisher. Printed in U.S.A. by Monumental Printing Co. at Baltimore, Md. The publisher assumes no responsibility for return of unsolicited manuscripts or art. When sending change of address, please list the old and the new address, and allow 3 weeks for delivery of first copy.

BPA

SIGNAL

Communications-Electronics-Photography

Journal of the Armed Forces Communications and Electronics Association

VOLUME XV FEBRUARY 1961 NUMBER 6

CONTENTS

Editorial—The Special Air Force Issue 6
W. J. Baird

The Role of Electronics in National Survival 7
James M. Bridges

Industry's Role in the Polaris Program 10
S. E. Hood and R. A. Gallagher

Managing Our Resources for Defense and Growth 21
George F. Metcalf

AFCEA's Role in the CIC 24
Ray E. Meyers

Signal Training Pays Off 28
Major Harry A. Nicoll, SigC, and Captain Clyde D. Merrick, SigC

1961 AFCEA Convention 37

The International Academy of Astronautics of the International Astronautical Federation 39
Andrew G. Haley

Military Oscilloscopes Pass Rigid Tests for Radio Interference 40
John Tatum

Starcom East Coast Relay System Completed 43
SIGNAL Staff Report

Timing Potentials of the Loran-C Clock 45
Gifford Hefley

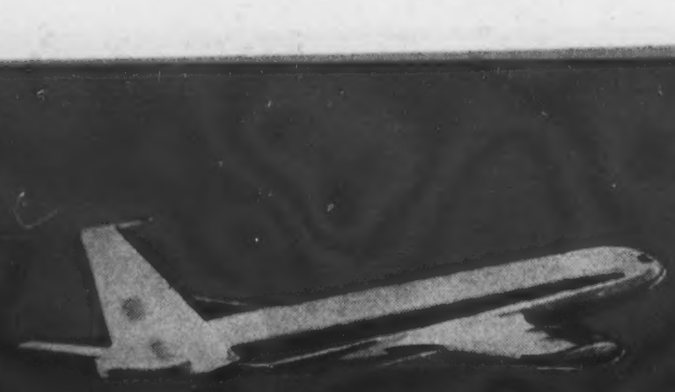
A Rose By Any Other Name 50
Department of the Army Report

COVER

The mighty Polaris is shown as it begins its ascent into a predetermined trajectory. Industry's role in the development of the Fleet Ballistic Missile system is reported on page 10 of this issue.

DEPARTMENTS

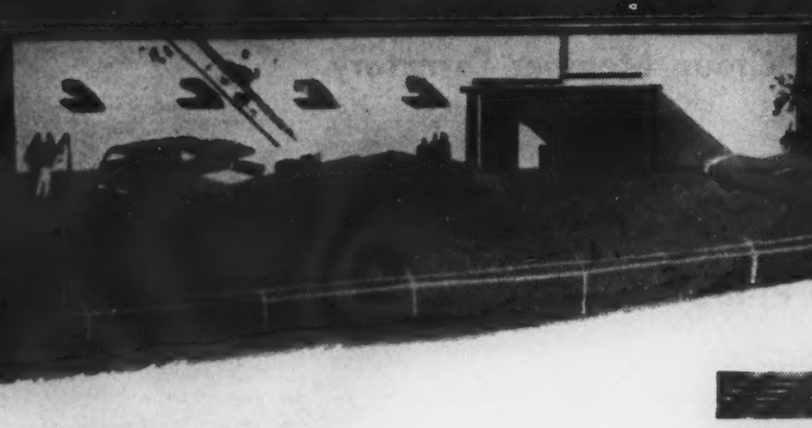
Signalgram 31
AFCEA Sustaining and Group Member Directory 51
Association Affairs 52
Chapter News 54
Association News 57
New AFCEA Members 59
News Items and New Products 62
Photoprogress 74
Names in the News 76
Index to Advertisers 80
Why Not Get a Friend to Join AFCEA? See Application on Page 80



FEDERAL AVIATION AGENCY relies on 6,174 miles of Collins microwave...

In a program to increase airways safety and traffic capacity, the Federal Aviation Agency has been building up its nation-wide network of surveillance and control radar. To date, Collins has provided 2,775 miles of microwave for remote control of these facilities, as well as communication and relay of radar pulse data. And by the end of this year another 3,399 miles of Collins microwave will have been added to the network. Collins was selected for this critical task because it could do the job economically, with equipment of proven quality and reliability. For information on how Collins may help you solve your own particular communications problem, contact Collins Radio Company, Texas Division Sales, 1930 Hi-Line Dr., Dallas 7, Tex.

COLLINS MICROWAVE AND CARRIER



COLLINS

COLLINS RADIO COMPANY • DALLAS, TEXAS • CEDAR RAPIDS, IOWA • BURBANK, CALIFORNIA

Where was the Bell Telephone System

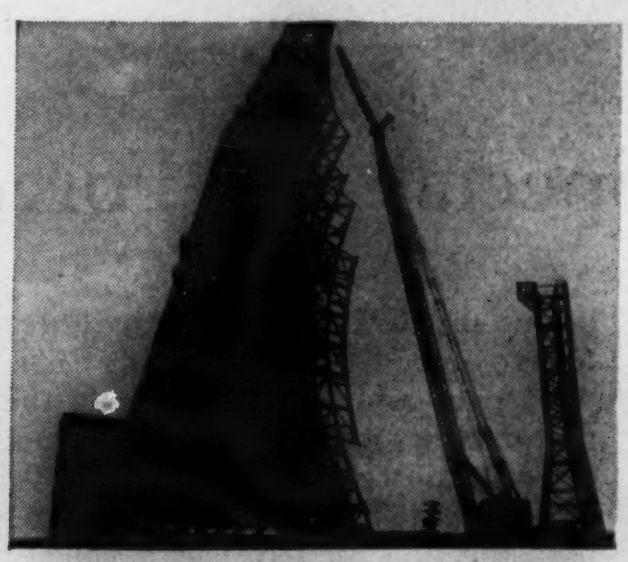
ON FRIDAY, AUGUST 12, 1960?

It was handling some 210,000,000 local and long distance conversations, plus about 5000 overseas calls.

It was guiding Echo I into near-perfect orbit so Bell System scientists could make the world's first telephone call via satellite.

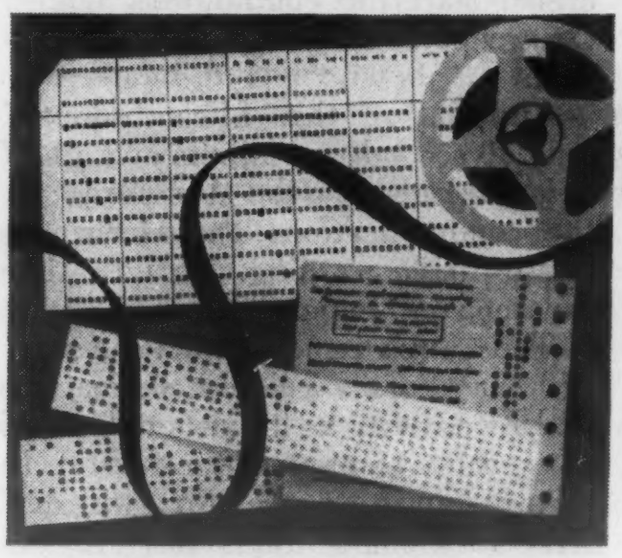
It was developing a world-wide communications system using satellites powered by the Solar Battery, a Bell System invention.

It was offering Bellboy personal signaling to more and more people. Device uses tiny Transistors, another Bell System invention.



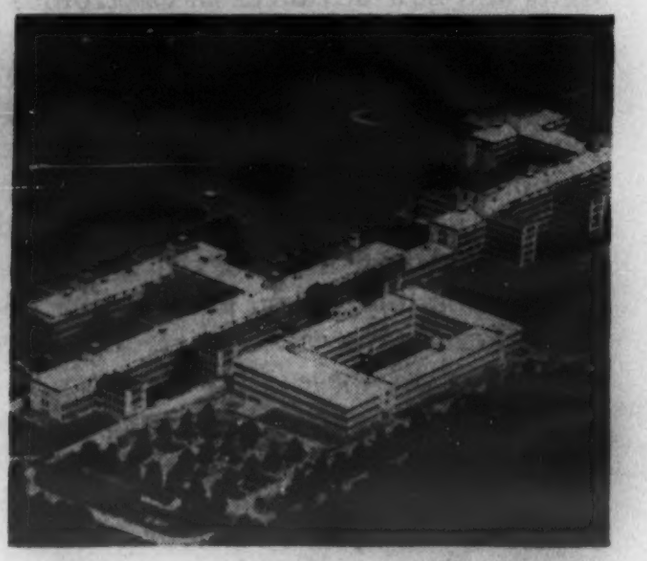
It was building fast, reliable communications for BMEWS—the nation's Ballistic Missile Early Warning System.

It was constructing a 'round-the-world communications system for America's first man (or woman) into orbit.



It was providing circuits for the speedy transmission of mountains of data for business and government.

It was providing thousands of miles of high-quality circuits for the country's local and network television programs.



And it was delving into innumerable fields of scientific inquiry at the largest industrial laboratories in the world.

It was at the scene of every major communications activity that day, as it is every day.

And for them all—communications on the ground, under the oceans, through the air, around the world—Bell Telephone people "wrote the book that everybody else uses."

How come? Because it's our job to be expert in universal communications.

You have a right to the best service in the world. *And you get it!*

BELL TELEPHONE SYSTEM *Pioneering in outer space to improve communications on earth*

W. J. BAIRD
General Manager and Editor

The Special Air Force Issue

THE ARMY, NAVY AND AIR FORCE, serving the Nation around the clock, are building today for a stronger defense for tomorrow. They realize not only the necessity for preparedness but, more precisely, appreciate that the delicate balance existing in the world between peace and war depends upon the power of communications and new advances in electronics technology. Communications is everyone's business and its recognized value differs not at all among the services. For they realize more than any other segment of our society that communications and electronics merge with the infinite. It is virtually impossible today to conceive of any military operation that does not depend upon these vital elements in one way or another. Communications and electronics are integrated into the civilian-military team complex as strongly as the main gears of mobilization preparedness are precisioned for national security.

In presenting our third special issue in military communications and electronics series, we are profoundly confident that the March Air Force issue will stand equally in importance with our 1959 Army issue and our 1960 Navy issue.

Let us consider the USAF and see why this special Air Force issue is important to the readers of SIGNAL and our friends.

Telecommunications and electronics in the United States Air Force today embodies a relatively new philosophy which has evolved in the past decade. Air commanders do not consider most elements of this rapidly growing science to be a purely support function of aerospace weapons. They are, instead, an integral part of these weapon systems because without communications and electronics their immediate response to command control on a global basis would be impossible.

It is generally common knowledge that the United States and its Allies are at all times subject to attack by the manned and unmanned weapons of a potential aggressor. Our armed forces must be prepared to meet such an attack with sufficient force to prevail over the enemy—to defeat his forces so completely that he would consider it folly to launch an attack.

This is the policy of deterrence—valid only if America's armed forces are strong enough to survive an initial attack and destroy the enemy's weapons of war; valid only if the United States is willing to use this force when necessary and if the forces and the will to use them are credible in an aggressor's eyes.

The USAF knows that its global forces can be credible only if they are capable of being launched within minutes—ICBM's, bombers, fighter-interceptors, tactical fighters — the works. These forces are kept ready to go within minutes, relying on a total of 15 minutes warning—15 minutes to see the portentuous blips of rising ICBM's, analyze them, collate them, determine their course and impact area, send the word from isolated arctic sites to command posts throughout the world, make decisions, exercise command, alert the crews, start the countdowns, launch the weapons and trigger defense action.

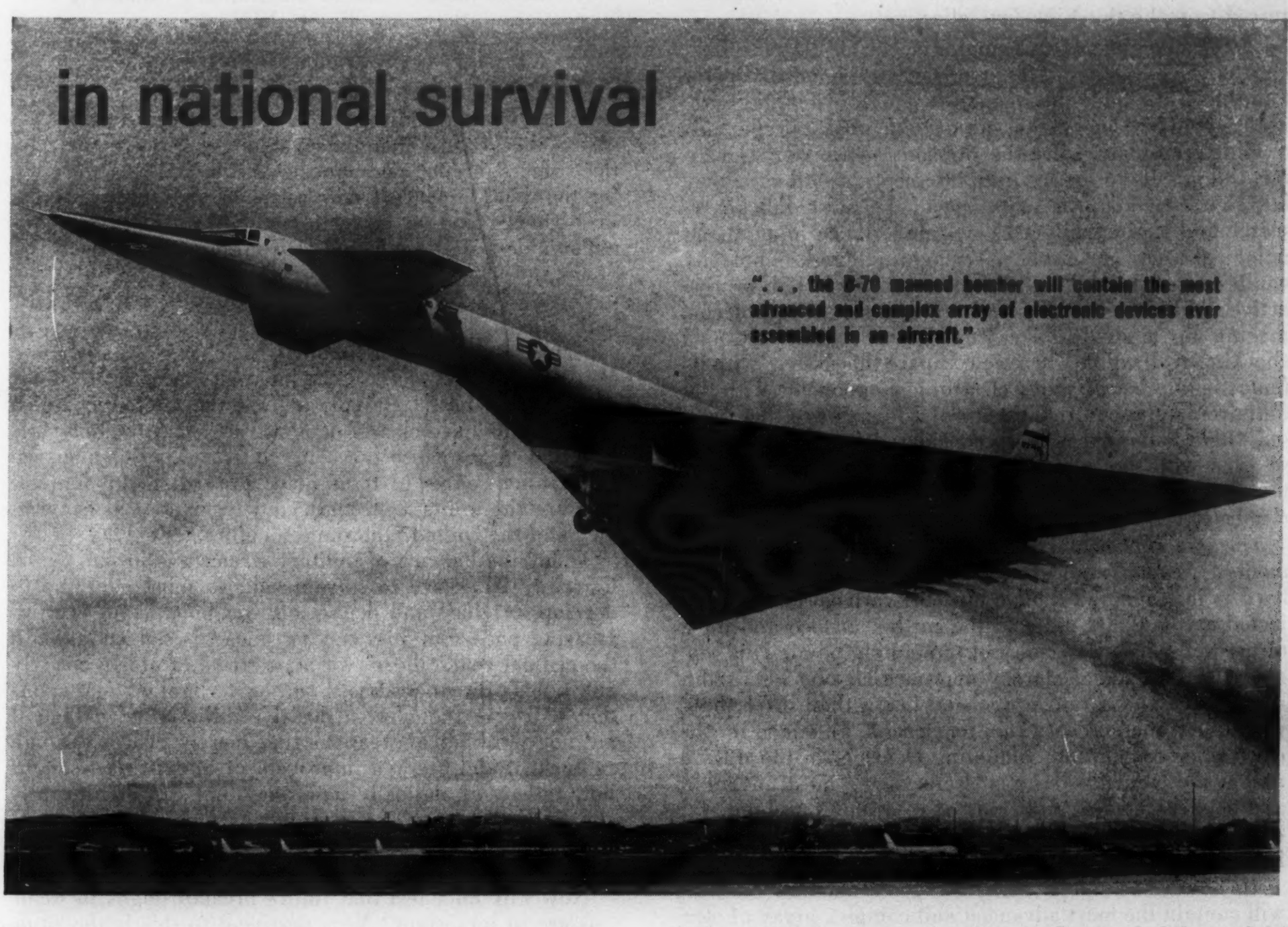
And out of this fifteen minutes, only 90 seconds—a minute and a half—is allocated by the Air Force for the communications and electronics phase of the warning. So little time for such an important task.

The March issue will tell the story of Air Force Telecommunications and Electronics as it exists today and is expected to exist in the future. In pictures and text, the story will deal with their daily functions. It will show the systems in action in all of their varied roles, innumerable aspects and uses. It will reveal their actual application in this unprecedented era of perpetual military preparedness.

Telecommunications and Electronics is not only an integral part of aerospace weapon systems, it is an integral part of national survival.

These areas of modern magic make our military services the most powerful force ever assembled to maintain world peace or win a war of incomprehensible magnitude.

the role of electronics in national survival


". . . the B-70 manned bomber will contain the most advanced and complex array of electronic devices ever assembled in an aircraft."

by JAMES M. BRIDGES
Director, Office of Electronics
Office of the Director of Defense
Research and Engineering

MY TOPIC IS ONE OF VITAL interest to every American. It is also a subject that is generally not too well understood or appreciated. We hear and read a lot these days about national survival and the strength of our military forces. But most of it concerns such things as ballistic missiles, bomber aircraft, nuclear-powered submarines and satellites. We hear very little about the fact that the successful operation of all these weapons and systems critically depends upon electronic devices and systems of fantastic complexity and precision—devices and systems, that, in almost every case, have pushed electronic technology to the limits of the state of the art and sometimes beyond. I want to tell you a little more about defense electronics and its significance in our endeavor to maintain a military strength sufficient to deter communist aggression.

Perhaps the best measure of electronics importance in defense is the amount of national effort and defense dollars being spent in this area. The military departments are currently spending around $6 billion a year for electronics research, development, engineering and production—well over one-half the total national output of our great electronics industry and almost one-quarter of the total defense expenditure for all research, development, engineering and production. Even more significant is the fact that approximately 40 percent of all military RDT&E (Research, Development, Test, Evaluation) funds is now going into the area of electronics. This tremendous military research and engineering effort employs around 80 percent of all the electronics scientists and engineers in this country.

· Obviously I haven't time to describe, or even list, the hundreds of different R&D programs that make up this vast national effort in electronics research and engineering—for instance, radar, infrared, computers, communications, acoustics, inertial guidance and electronic components. Nor can I take time to explain the vital part played by electronics in each of our modern military weapons and systems. Instead, let me give just a few specific examples illustrating how critically the success of our military operations depends on electronics.

The development of the Nike-Zeus anti-ballistic missile defense system provides a good illustration. I suspect that most people realize that difficult technical problems are involved in producing a missile with the range, speed, maneuverability and lethality it must have to intercept

and destroy an ICBM warhead entering the atmosphere at perhaps twenty times the velocity of sound. But I doubt that many recognize that the complex and challenging problems of the missile's design are dwarfed by the technological difficulties involved in developing the radars and computers and the other electronic control devices required to make the Nike-Zeus effective.

The development of these major electronic systems, having the range capabilities, precision and speed of operation that will enable the weapon system to detect the warhead, identify it among the decoys and rocket fragments, track it accurately, solve the fire-control problem and direct the missile to an accurate interception—all in a very few short seconds—presents one of the most difficult research and engineering tasks ever undertaken in any technological area. The problem's magnitude and complexity can be seen from the fact that there are some half-million active semiconductor devices in the electronic equipments making up a single Nike-Zeus defense center. It is a shocking realization when we compare this system with its fantastic number of active electronic components with the antiaircraft fire-control systems of 15 years ago that, with only 500 vacuum tubes, were considered fearfully complex or even with the most modern surface-to-air antiaircraft missile system, which has about 2,000 active electronic elements.

The intercontinental ballistic missile is also typical of modern weapons; absolute reliance on electronics. It is hard to imagine that a huge nuclear warhead can be projected across 8,000 miles of the earth's surface and hit a target well within two miles of the aiming point. This represents an angular accuracy approaching one hundredth of a degree and a range precision better than three thousandths of one percent. This remarkable guidance by the electronic sensing and computing elements in the missile and at the launcher represents one of the most advanced and sophisticated applications of electronics technology; it took thousands of man years of scientific and engineering effort to develop.

In another weapons area, the B-70 manned bomber, will contain the most advanced and complex array of electronic devices ever assembled in an aircraft. It has been estimated that the development and engineering of the bombing-navigation system alone will cost close to a quarter of a billion dollars and will require 8,000 to 10,000 man years of engineering. This is only one of the major electronic subsystems this advanced aircraft weapon system will need to perform its mission.

Probably the most exacting use of electronics in our whole defense program is in space developments. Certainly a space system depends more completely upon electronics than any other in civilian or military use. Once a rocket carrying a satellite into orbit leaves the launching pad, only by means of electronics can we obtain information from the space vehicle, whether it concerns the vehicle's precise location or data acquired by its various sensing instruments, most of which are themselves complex electronic devices.

In one of our current military space programs, the satellite carries equipment employing some 28,000 electronic parts—about equivalent to 100 home television receivers. To be operationally and economically feasible, this complicated equipment must operate satisfactorily in space, with no adjustment or maintenance, for long periods of time, perhaps a year or more. Can you imagine turning on 100 television sets and letting them run continuously for a year without having to adjust one set or replace a single defective part? Attaining reliability of electronic equipment that is essential for space applications poses a tremendous engineering problem. It will call for the development of electronic components and construction techniques that are far more reliable than those available today.

I hope these few examples make it fairly clear that electronics is the keystone of our military capability and, in most cases, the controlling technology.

Across-the-Board Technology

Now I would like to mention the critical and urgent need for more rapidly advancing electronics technology across the board. This we must do to acquire the new electronic concepts, components and techniques we need for the development of new weapons and space systems so advanced and so powerful that they will give us an undeniable—and, we hope, discouraging lead over the Soviet.

Certainly I need not belabor the point that we must maintain such a position of military and technological superiority over the communist nations. From the time Mr. Khrushchev scuttled the Summit meeting until recently, when he "declared war" on the United Nations, world events have clearly demonstrated that the only factors that might cause the communist powers to alter the frightening course of their drive toward world domination are the military strength and technological achievements of the United States and its allies.

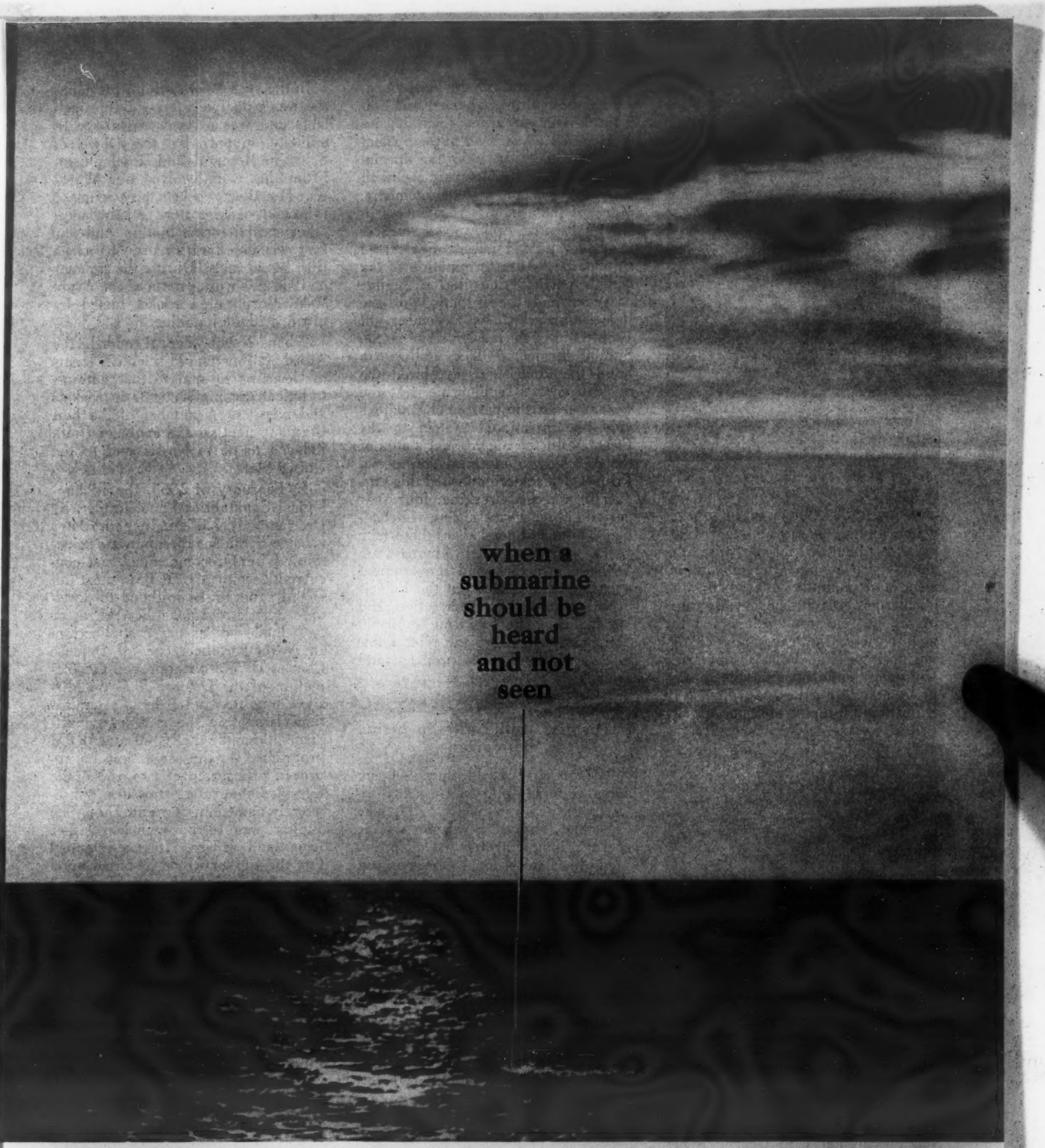
Today the balance of military strength is in our favor. Certainly if we are to stay ahead, we must continue to develop, produce and deploy our weapons at an ever-increasing pace. But just staying ahead is not enough. In the critical years ahead, we must strive to create entirely new kinds of weapons based on new technology—weapons that will give the West a decisive military advantage. I am not speaking of weapons that merely evolve through refinement and gradual improvement of existing weapons but, rather, of radically new ones that can significantly change the balance of power in our favor. What sort of weapons these new ones will be, I cannot say: the atomic bomb was one; the ICBM was another.

Now why do I feel that future breakthroughs in weapons are so important? Very pertinent to this is the situation I see developing in the major strategic forces that constitute our deterrent and retaliatory power, which is so vital to our national survival. Our powerful strategic striking force of manned bombers, an extremely important part of our deterrent strength, is currently undergoing a rapid transition. It is being complemented by a family of ICBMs: The Atlas is now operational, the submarine-launched Polaris entered the Navy's operational forces last fall, and the Titan will be added to our operational ICBM forces the middle of this year. In addition, the development of Minuteman, which has a shorter reaction time, greater reliability and better performance than Atlas, is being accomplished on an accelerated schedule.

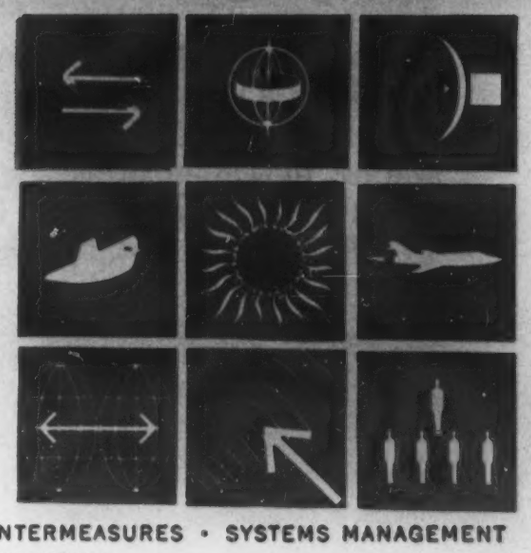
Balance of Strength?

With this rapid expansion of ICBM strength, both in the United States and the U.S.S.R., it seems obvious to me that, unless disarmament negotiations are successful, there will develop within a very few years a balance of deterrent strength between the communist and Western powers that will constitute a deadly and frightening stalemate of missileborne destructive power. Each side will have a sufficient number of these missiles—dispersed, hidden and protected by site hardening—for a potentially complete mutual destruction, even on a "strike second" basis. When such a weapon stalemate exists, it seems most

(*Continued on page* 47)



The AN/WRA-2 Antenna is the most efficient h-f antenna yet developed for submarine use. It is part of a complete communications system designed and manufactured by Hoffman for use on our Navy's nuclear-powered submarines. Fully retractable and built to withstand sea-pounding punishment, this Hoffman antenna is also adaptable for surface vessels and hard base missile sites.



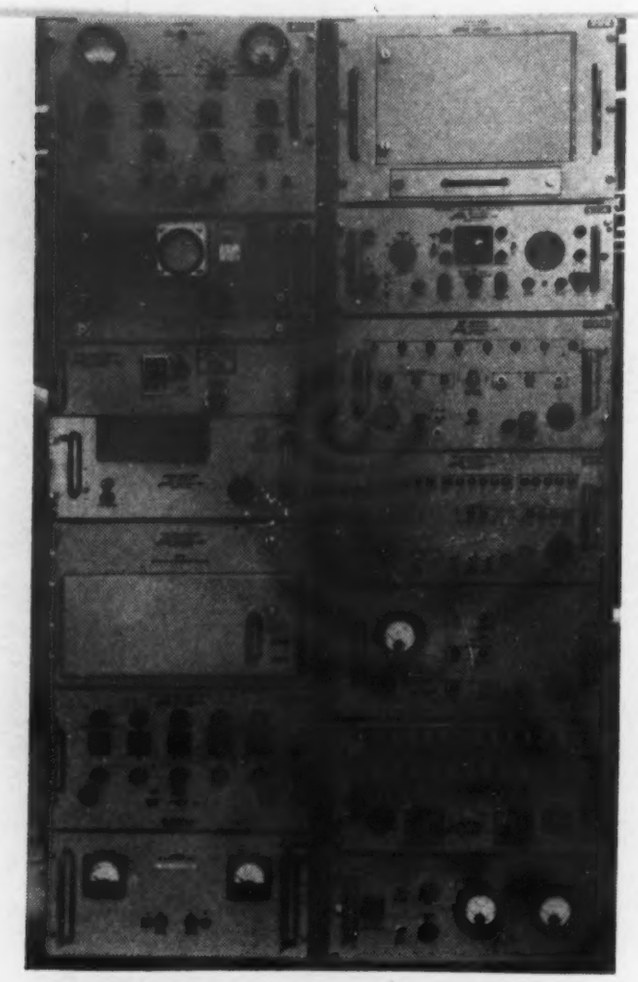
Hoffman / ELECTRONICS CORPORATION

Military Products Division

3740 S. Grand Avenue, Los Angeles 7, California

COMMUNICATIONS • ELECTROMECHANICAL • RADAR • ASW • SOLAR POWER • NAVIGATION • FIELD SERVICES • COUNTERMEASURES • SYSTEMS MANAGEMENT

SIGNIFICANT DEVELOPMENTS AT HOFFMAN HAVE CREATED POSITIONS FOR SCIENTISTS AND ENGINEERS OF HIGH CALIBER. PLEASE ADDRESS INQUIRIES TO VICE PRESIDENT, INDUSTRIAL RELATIONS



"THE POLARIS SUBMARINE SYSTEM will combine the advantages of attack by ballistic missile with the already proven potential of concealment and mobility offered by the nuclear-powered submarine. By moving about, remaining submerged for long periods and constantly changing positions, the Polaris submarine will be virtually invulnerable to surprise attack. Further, it will remove a portion of that which necessarily will be an enemy's primary target—our own strategic striking force—far away from our shores and population centers. Hardened missile sites within our own borders will invite heavier and heavier megaton weapons to effect their destruction. The Polaris system will take our missile bases to sea."[1]

The Polaris weapon system consists of the nuclear-powered submarine, complete with necessary navigation, fire control and launching equipment, and the Polaris missile. Polaris is a two-stage intermediate-range ballistic missile commonly referred to as the Fleet Ballistic Missile, (FBM). It carries a nuclear warhead and is designed to be launched from the submerged submarine. It may, however, be fired from surfaced submarines, ships or shore installations. The Polaris armament of the operational *USS George Washington* (SSBN 598) and the *USS Patrick Henry* (SSBN 599) is designated the A1 and has a range of 1200 nautical miles (1380 statute miles). Future development is scheduled to give the missile a range of 1500 n.m., by 1962, the A2 and, by 1965 a range of about 2500 n.m., the A.3.

[1]*Admiral James S. Russell, Vice Chief of Naval Operations, November 2, 1959.*

Vice Admiral William F. Raborn, Jr. has been directing the Fleet Ballistic Missile program since its inception in 1955 as head of the Special Projects Office. In 1955, the Special Projects Office began operation with seventeen specially selected members. Many of these men were pioneers in Navy's Regulus program (a surface-to-surface guided missile fired from shipboard). After termination of the Navy's participation in the Jupiter program and the initiation of the Polaris program in December of 1956, it was the assignment of the Special Projects Office (SPO) to build the Polaris missile, build the nuclear-powered submarine, test the system, train the personnel and provide an operational system to the Fleet. With the operational status of the A1 class submarines, the Special Projects Office accomplished this mission in a record-breaking, four year period—three years ahead of schedule. Three and one-half of these four years were utilized by more than 6,900 contractors and government agencies who carried out the Polaris program under SPO direction and integration. The following information briefly describes the remarkable history of the Polaris program and the role of major contractors in this achievement.

I. History of the Missile Firing Submarine

The origin of the missile-firing submarine is found in Germany towards the end of World War II. The Germans designed a weapon on the rocket principle against the mounting pressure from enemy U-boat chasers, corvettes, frigates and destroyers. These rockets were launched at the pursuer by the submerged boat in salvoes of four. The damage caused by the 15 kg. explosive charge sufficed to make the pursuer give up the chase. The aim was based on data obtained by the sound-locator and predictor—a mechanism which computed the aiming triangle. One German project included a submersible launching platform about 100 feet long in the form of a large container, housing a V2 rocket with a gyro-stabilized firing platform which could keep the missile steady regardless of sea swell. Each container weighed approximately 500 tons and a submarine could tow three of them. At the end of the war this weapon system was still in the test stage and it was not used operationally.[2]

[2]*"German Secret Weapons of Second World War," p. 218. Rudolf Lusar and "The Soviet Air & Rocket Forces," p. 151. Edited by Asher Lee.*

In the year 1942 work in this country was principally on solid propellants and was carried forward with military support by the Office of Scientific Research and Development. From this work evolved our World War II artillery rockets, air-to-surface rockets, rocket boosters for airplanes, other special rocket motors, and our first serious efforts to propel rockets with liquid fuels. During the summer of 1945 this work produced the Army WAC Corporal, a rocket fueled by nitric acid and aniline.

When World War II ended, the Allied Nations placed scientific teams in Germany to analyze that nation's technical accomplishments in rockets and missiles. A number of the best German scientists and engineers were induced to go to Russia and to the United States.

In February of 1955, the Technological Capabilities Panel headed by Dr. James R. Killian, Jr. (who later became President Eisenhower's scientific adviser) recommended that concurrently with the ICBM effort an IRBM program be initiated to develop a missile of 1500 miles range for both land and sea based application. In November, Secretary of Defense Charles E. Wilson approved the formation of the Defense Ballistic Missile Committee and ordered organization changes in the military departments to handle the ICBM and IRBM programs. At the same time he approved a program of two 1500 mile intermediate range missiles subsequently named Jupiter and Thor. The Jupiter was to be launched either from land or sea. It was intended that the Jupiter would be based upon experience gained by the Redstone Arsenal team from the V2 and Redstone missiles.

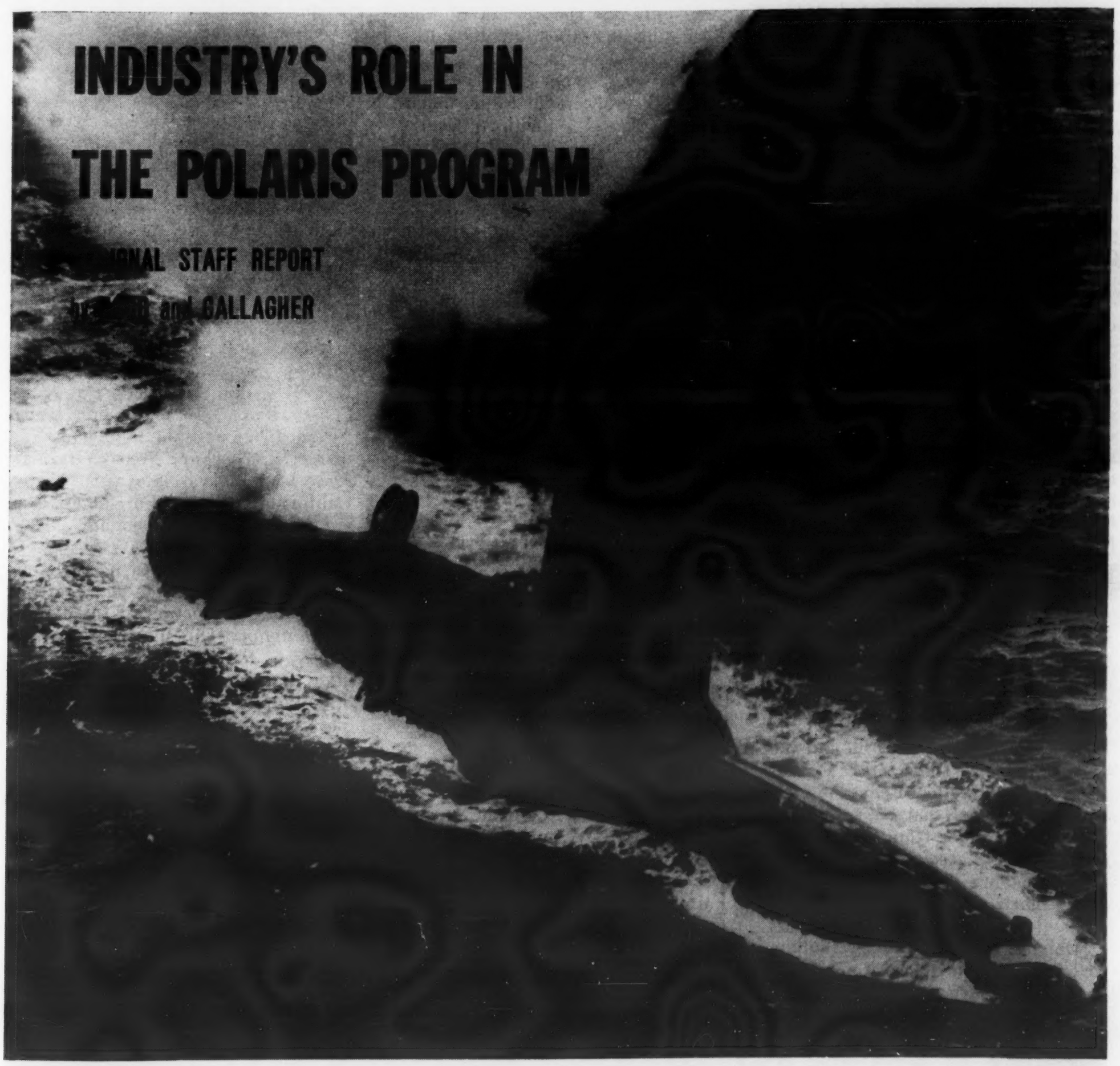
A joint management committee was established by the Army and Navy for the Jupiter program. The Navy created the Office of Special Projects with William F. Raborn, Jr., then a newly selected Rear Admiral, in charge and assigned to it responsibility for the technical development of the sea-going portions of the joint Army-Navy Jupiter Program. Early in 1956, as a corollary to the Jupiter program, which employed a liquid propellant, the Navy also began studies of a solid propellant version to reduce shipboard logistical problems. Use of the liquid propelled Jupiter would necessitate high pressures and extremely low temperatures for storage, transport and loading of the fuels. The large and complex installations required to meet these conditions were unacceptable for shipboard application. A solid-fuel

rocket would eliminate the safety hazard besides having the advantages of low maintenance requirements, higher inherent reliability and instant fuel capability. The original design of the solid propellant version of Jupiter called for a multi-stage clustered solid propellant power plant of enormous size. After extensive design studies based upon AEC predictions of major reductions in warhead weight, it was decided that an entirely different missile envelope would be most suitable and the Polaris design was evolved.

In March 1956, the Office of the Secretary of Defense/Ballistic Missile Committee approved Navy's Jupiter solid propellant program for component development to determine weapon system feasibility. Authorization was received for a navigation development program, a weapon system test and development program, an FBM surface combatant development program, and an FBM submarine development program—all based on Jupiter.

In October 1956, the Scientific Advisory Committee recommended initiation of a new, smaller, solid-propellant IRBM with improved capability of being launched from a submarine. In November 1956, Secretary of Defense Wilson reviewed Service responsibilities for operational use of the IRBM. He assigned responsibility for operational deployment of land-based IRBM's to the Air Force and ship-based IRBM's to the Navy. In December the development of the Polaris (solid-propellant) IRBM (including six submarines) was approved by Wilson, and the Navy was authorized to terminate its participation in the Jupiter program. Following Navy withdrawal from the Jupiter program, separate Army and Navy Ballistic Missile Committees were established under the chairmanship of the respective Service Secretaries—Navy Secretary Charles S. Thomas and Army Secretary Wilber M. Brucker. The Navy ballistic missile development work was moved

Typical of the multiple complex equipment developed by industry for the Polaris program is the Timing and Control equipment (opposite page) developed by Interstate Electronics Corp., Anaheim, Calif., for instrumentation of underwater firings. (below) The USS Patrick Henry *test firing a missile.*



from Huntsville to the laboratories of its major contractors—extending from Lockheed Aircraft on the West Coast to the Massachusetts Institute of Technology on the East Coast.

In January 1957, the Special Projects Office established a Steering Committee composed of twelve top scientists from industry, university and government laboratories to define the optimum Polaris submarine parameters including subsystem parameters. This work was completed in a period of three months. They considered such items as performance characteristics required, the size to build the submarines, how many missiles to be carried in each submarine, the size of the missile and the size of the guidance system. In the next step, Special Projects optimized the systems' individual parts and put them together into a single weapon system geared to the predicted state-of-the-art in 1963.

The Atomic Energy Commission succeeded in reducing the nuclear warhead weight and size. This, coupled with the earlier breakthroughs in solid-propellant research made by Atlantic Research Corporation made possible further advances as did miniaturization of the guidance system. In 1957, Lockheed Aircraft Corp., missile systems manager and prime contractor for the Polaris missile, was designing the missile and mapping out work for hundreds of missile subsystem contractors. Electronic problems involved in precise underwater navigation, missile guidance, control of the computation elements, communications with the submarines and other factors were concentrated upon by research specialists at General Electric, Sperry Gyroscope, Westinghouse, various Naval bureaus and activities, and many others. Progress was being made in an orderly fashion.

On October 4, 1957 the Soviet Union launched Sputnik I. With the aid of appropriations speedily made available, the Navy Ballistic Missile Committee instigated and obtained approval for a crash program for the Polaris project. Contractors and the Special Projects Office Staff accelerated the program. Rear Admiral Raborn reasoned that by sacrificing 300 nautical miles from the missile's range and by accelerating all parts of the system's development, a 1200 n.m. Polaris could be operational by 1960. In December 1957, Secretary of Defense Neil H. McElroy authorized acceleration of the Polaris program to achieve completion of the first Polaris submarine weapon system in 1960.

Throughout the Polaris development program, all major objectives have been achieved. The launching system for the first Polaris submarine passed its test with a full scale Polaris test vehicle from a submerged launcher off San Clemente Island, California. The *USS George Washington* was launched from Groton, Connecticut on June 9, 1959 and was commissioned December 30, 1959.

On July 20, 1960 the last major milestone prior to operational deployment was passed when two heavily instrumented Polaris missiles were launched from the *George Washington* while submerged and went over 1,000 nautical miles to the target area. In October 1960, the *USS Patrick Henry* (commissioned April 9, 1960) scored four successful missile launches out of four tries. An earlier series of tests from the *Patrick Henry* scored only one success out of four launches because of certain difficulties with the missiles. On November 10, the Polaris A2 successfully flew more than 1600 statute miles (1400 n.m.). On November 15, the *USS George Washington,* armed with 16 Polaris missiles was deployed. On December 30, 1960 the *USS Patrick Henry* commenced its first operational patrol. The *USS Robert E. Lee* (SSBN 601) will become operational early this year. Eleven other FBM submarines are under construction and will be deployed at regular intervals.

II. Role of the Contractors

Many AFCEA sustaining and group members have done work on the Polaris program. The forty-four companies listed below are Polaris prime contractors, according to Navy Department records. Other companies have received subcontracts for Polaris work, but this list is not complete.

American Machine & Foundry Co.
Amphenol/Borg Electronics Corp.
Autonetics, Division of North American Aviation, Inc.
Bell Telephone Laboratories Inc.
Bendix Radio Division, The Bendix Corp.
Burroughs Corp.
Collins Radio Co.
Convair/Pomona, Convair Division of General Dynamics Corp.
Crosley Division, Avco Corp.
Developmental Engineering Corp.
Fairchild Camera & Instrument Corp.
General Electric Co., Defense Electronics Div.
Hallamore Electronics Co.
Hoffman Electronics Corp., Military Products Div.
Hughes Aircraft Co.
International Business Machines Corp.
International Telephone & Telegraph Corp.
Litton Industries, Inc.
Lockheed Aircraft Corporation
Magnavox Co., The
Melpar, Inc.
Motorola Inc.
National Co., Inc.
Northrop Corporation
Philco Corp.
Radio Corporation of America
Radio Corporation of America, Defense Electronic Products
Raytheon Co.
Reeves Instrument Corp.
Ryan Aeronautical Co.
Sperry Gyroscope Co., Division of Sperry Rand Corp.
Stanford Research Institute
Stewart-Warner Electronics, Div. of Stewart-Warner Corp.
Stromberg-Carlson Co., Division of General Dynamics Corp.
Sylvania Electric Products Inc.
Technical Materiel Corp., The
Teleprinter Corp.
Teletype Corp.
Tung-Sol Electric Inc.
Varian Associates
Waterman Products Co., Inc.
Western Electric Co., Inc.
Westinghouse Electric Corp.
Westrex Corp., a Division of Litton Industries, Inc.

• *The FBM Submarine*

Major contractors for the Polaris launching submarines are the Electric Boat Division, General Dynamics Corporation, Groton, Connecticut; Newport News Shipbuilding and Drydock Co., Newport News, Virginia: Mare Island Naval Shipyard, Vallejo, California; and, the Portsmouth Naval Shipyard, Portsmouth, New Hampshire.

The Bureau of Ships in 1958, directed Electric Boat to move at top speed on construction of the *George Washington*. On the ways at the time was the keel of the *USS Scorpion*, a nuclear attack submarine of the *Skipjack* class. The *Scorpion* was cut in two and a 130 foot missile section was inserted to convert the hull to the first FBM submarine. Electric Boat wrote 40,000 purchase orders to subcontractors before the $100,000,000 submarine went down the ways in the record time of less than sixteen months from contract signing.

FBM submarines of the *George Washington* class, which fire the A1 Polaris, are about 380 feet long with a beam of about 33 feet and displace about 5900 tons. This class includes

(*Continued on page* 14)

PROJECT HEAT FOR MILITARY APPLICATIONS

In cooperation with research and engineering commands of the U.S. Armed Forces, Hunter Manufacturing Co. for more than twenty years has specialized in the design, development and manufacture of multi-fuel-burning heating systems.

Hunter heating systems with *sealed-in-steel* combustion are employed for a wide variety of military uses—for space and personnel heating in mobile shelters, in portable or fixed structures of many different types, in self-propelled vehicles, in ground support systems for missiles, in radar and microwave systems, etc.

Other types of Hunter systems are widely used in winterization operations, for engine pre-heating, for emergency heating requirements and for many other using arm operations. Hunter heating systems are designed for cold starts down to 65° below zero and are air-circulating in type with thermostatic controls. Uncontaminated heat capacities range from 15,000 to 300,000 BTU/hour.

If you have a problem involving the application of heat, Hunter can help you solve it.

Complete research and development facilities available. Contact:

HUNTER
MANUFACTURING CO.
30531 AURORA RD. • CLEVELAND 39, OHIO

SPECIALISTS IN HEAT FOR MILITARY APPLICATIONS

the *George Washington* (SSBN 598), the *Patrick Henry* (SSBN 599), *Theodore Roosevelt* (SSBN 600), *Robert E. Lee* (SSBN 601), and the *Abraham Lincoln* (SSBN 602). Both the *George Washington* and *Patrick Henry* were built by Electric Boat. The *Roosevelt* is being built at the Mare Island Naval Shipyard; the *Robert E. Lee* is being built at the Newport News Shipbuilding and Drydock Co.; and, the *Abraham Lincoln* is under construction at the Portsmouth, N. H. Naval Shipyard. These three submarines will join the Fleet this year.

The *USS Ethan Allen* (SSBN 608), which began the second generation of Polaris submarines, is now being built by Electric Boat. Others of this class are the *USS Sam Houston* (609), being built at Newport News; the *Thomas A. Edison* (610) at Groton; and, the *John Marshall* (611) at Newport News. The *Ethan Allen* was launched November 22, 1960; the other three will be launched this year and will become operational this year and in 1962. The *Ethan Allen* class ships are 410 feet long, 30 feet longer than the *George Washington* class, and will displace about 6,900 tons. Both classes carry 16 Polaris missiles stored in eight pairs of vertical launching tubes in the space immediately behind the sail. Each submarine has a 300 ton capacity air conditioning plant and is equipped with air scrubbers and precipitators to remove irritants from the air and maintain the proper balance of oxygen, nitrogen and other atmospheric elements. Electrolytic oxygen generators under development will permit the submarines to manufacture their own oxygen from sea water.

The lead ship in the third class of FBM submarines is the *USS Lafayette* (616). The *Lafayette* is the first in this class being built under the fiscal year 1961 shipbuilding program by the Electric Boat Division. The *Lafayette* class will be 425 feet long, and will displace about 7,000 tons and is scheduled for 1964 operational status.

Construction of five Polaris submarines will be started this fiscal year. The *USS Thomas Jefferson* (SSBN 618) will be of the *Ethan Allen* class and is to be built by the Newport News Shipbuilding and Drydock Co. The *USS Alexander Hamilton* (SSBN 617) will be built by Electric Boat Division; the 619 and the 620 will be built by Mare Island and Portsmouth respectively. These three are of the *Lafayette* class. The 619 and 620 have not been assigned names.

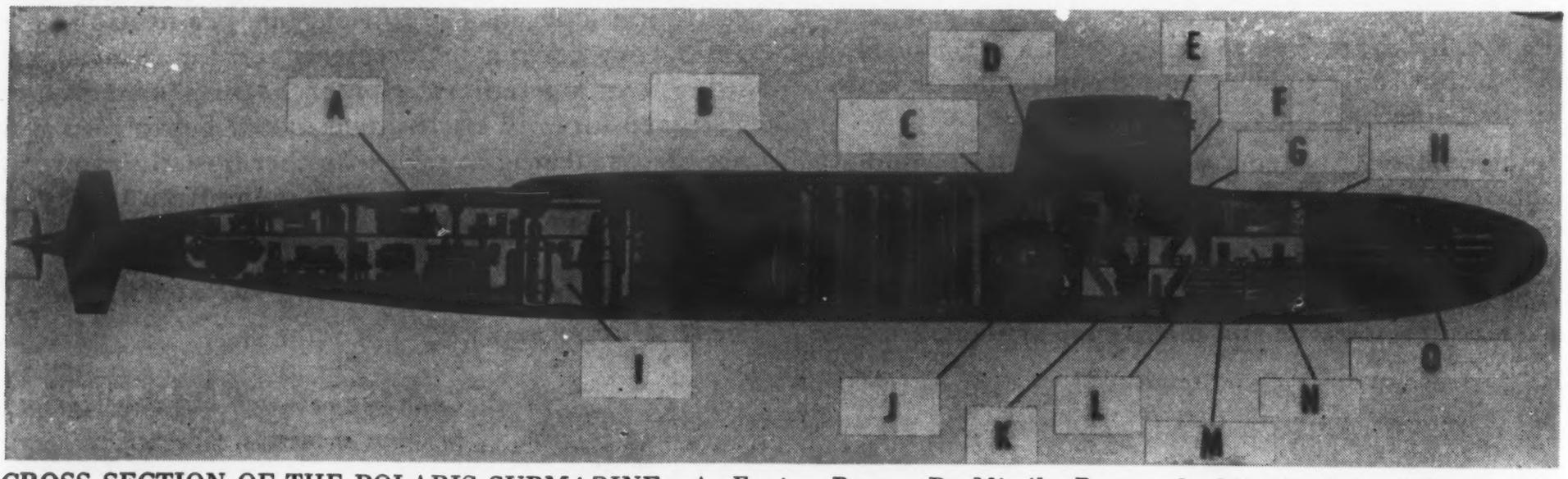
Therefore, the total of FBM submarines commissioned, launched, under construction, and construction authorized is fourteen. Procurement of long lead time items has been authorized for five more FBM submarines bringing the grand total to nineteen. Authorization to procure long lead time items for the remaining two of the seven voted by the Congress would bring the grand total of FBM submarines to twenty-one.

Each FBM submarine has two crews, called Blue and Gold, of about 100 men and officers. The crews, with the Blue normally taking first duty, will alternate on the long patrols with the off-duty crew employed in training ashore at specially designed team training simulators. Commanding officers of the *USS George Washington* are Commanders James B. Osborn (Blue Crew) and John L. From, Jr., (Gold Crew). Commanding the *USS Patrick Henry* are Commanders Harold E. Shear (Blue) and Robert L. J. Long (Gold). Commanders William E. Sims (Blue) and Oliver H. Perry (Gold) will skipper the *USS Theodore Roosevelt;* Commanders Reuben F. Woodall (Blue) and Joseph Williams, Jr., (Gold) will command the *USS Robert E. Lee;* and, Commanders Leonard Erb (Blue) and Donald M. Miller (Gold) the *USS Abraham Lincoln.*

• *Fire Control*

The fire control system feeds coordinated information to the missile guidance system as to ship location, local vertical, true north, target location and trajectory to be flown. Corrections are supplied until the instant of firing. The fire control mechanism can prepare missiles for launch at a very rapid rate. The General Electric Ordnance Department, Pittsfield, Massachusetts, is responsible for design, development and production of the MK 80 fire control system now operational aboard the *USS George Washington* and submarines of the 598 and 608 classes, and for the MK 84 fire control system for the third generation FBM system. The MK 84 awarded to GE under a $34 million contract, is now in the design stage.

Basically, the fire control system contains a battery of computers, both analog and digital, which constitute the brain of the system. Information on ship's position, direction and velocities is received from the SINS. Target data is fed into the computers. The intelligence thus derived is transmitted to the guidance system of the missile. The computers transfer and verify data at rates measured in split seconds. As the ship moves prior to launching of the missile, the fire control system makes constant corrections to the guidance information. These computers used in the fire control system incorporate the most modern electronic features. Transistorized plug-in type printed wiring boards facilitate equipment miniaturization, assembly, maintenance, reliability and improved high speed performance. In addition to its primary function of providing the Polaris missile's inertial guidance system with all the information necessary to guide the missile successfully to its target, the fire control system



CROSS SECTION OF THE POLARIS SUBMARINE: A, *Engine Room;* B, *Missile Room;* C, *Missile Control Center;* D, *Navigation Room;* E, *Bridge;* F, *Periscope Room;* G, *Control Room;* H, *Officers Wardroom;* I, *Reactor Room;* J, *Gyro Room;* K, *Stores;* L, *Batteries;* M, *Crew's Quarters;* N, *Crew's Mess;* O, *Forward Torpedo Room.*

provides information required for monitoring the status of the entire system and launching.

• ***Navigation for the Submarine***

Two positions must be known for success in missile launching—the target's and the launcher's. This puts great importance on navigation in the FBM system since the position of the launcher is the position of the ship and it is constantly changing. Navigation guides the submarine, giving it unfettered mobility. Secondly, navigation assembles the data to start the missile on its way. It must furnish the fire control center with an *exact* knowledge of the missile's position, the direction it faces and its basic equilibrium. A single degree error in compass direction would throw the 1200 n.m. Polaris twenty miles off course.

The Special Projects Office requires a self-contained navigation system for the FBM submarine which can precisely pin-point a missile-carrying ship's position in latitude and longitude beyond the sight of land and beneath the sea without the use of external references, earth bound or celestial. Several methods complement each other in the FBM submarine to provide a very high order of accuracy in determining the ship's position. Core of the FBM system is the SINS (Ship's Inertial Navigation System), a complex system of gyroscopes, accelerometers and computers, which relates movement of the ship in all directions, ship speed through the water and over the ground, and true north to give a continuous report of ship position.

Basically, an inertial navigation system consists of three gyros and two accelerometers mounted on a platform, and some form of computer. Accelerometers are small mechanical devices that respond to accelerations of the vehicle and give an output of vehicle velocity north and east. The stabilized platform isolates the accelerometers from rotational motions of the vehicle and maintains the proper orientation of accelerometer axes. The critical components are the stabilization gyros and the accelerometers.

Disturbances due to imperfections in the gyros can cause the platform to drift or rotate slowly. This drift rotation causes misalignment of the accelerometers with resulting errors in navigation. Various means are thus available to reset the inertial system and sustain accuracy. A number of equipments are included in the submarine navigation system to provide an all weather capability of checking on the accuracy of SINS. These include both optical and electronic devices—all highly automated. Since the inertial guidance system is based entirely on measurements of acceleration, and involves no contact with the world outside the submarine, there is no known way of interfering with its operation.

Each FBM submarine has three SINS, each checking on the other through a master digital computer. Systems similar to the SINS used in FBM submarines guided the *Nautilus* and *Skate* on their historic voyages beneath the polar ice in 1958 and, more recently, *Triton* on her 84-day underwater cruise around the world. The converted Mariner class cargo ship, *USS Compass Island* (EAG 153), serving as navigation test ship has steamed well over 100,000 miles in development tests of the submarine navigation system.

The Instrumentation Laboratory of the Massachusetts Institute of Technology under the direction of Dr. C. Stark Draper, developed the design concepts for the SINS. Dr. Draper and his associates developed inertial navigation systems in the late 1940's, first for aircraft, then for naval vessels. SINS work, sponsored by the Navy, was performed at this Laboratory in the late 1940's and early 1950's, before evolution of the submarine-launched ballistic missile concept. When the Polaris program was started, it was found the SINS ideas and designs fitted in perfectly. Dr. Walter Wrigley, professor of aeronautics and instrumentation at M. I. T. and educational director of the Laboratory, together with Mr. Forrest E. Houston, a Laboratory associate director, and Dr. Joseph DeLisle, a Laboratory assistant director, headed the work which led to development of SINS at M. I. T.

Major contractors for the submarine navigation system are Autonetics Division, North American Aviation, Inc., Downey, California and Sperry Gyroscope Company, Division of Sperry Rand, Inc., Great Neck, Long Island.

Late in 1957, the Navy asked Autonetics to take out of mothballs an N6A inertial navigation system from the cancelled Navaho missile program for trial in *Compass Island*. In April 1958, the Navy's SPO awarded Autonetics a $6.7 million contract to design and fabricate the N7A inertial navigation equipment for the first FBM submarine. Four months later, the Navy used the N6A to help guide both the *Nautilus* and *Skate* on their voyages.

All mathematical computations for the N7A system are performed by a digital computer called Verdan. This advanced computer, which is approximately 1½ cubic feet in over-all size, can be programmed to permit accurate navigation over all regions of the earth. Autonetics-produced SINS are aboard the *George Washington, Patrick Henry* and *Theodore Roosevelt,* and are scheduled for the *Abraham Lincoln* and *Robert E. Lee.*

Sperry's Gyro Navigator is an outgrowth of the inertial system originally developed by Dr. Draper at M. I. T. Sperry continued its development under the SINS name and finally trademarked it the "Gyro Navigator." Sperry's system uses "weightless" gyros to gain maximum sensitivity and is equipped with either digital or analog computers into which the data feeds. For polar operation it can be oriented to space rather than earth in order to avoid loss of directional force imposed by the earth's rotation. Both Sperry and Autonetic's SINS use the NAVDAC computer, a Sperry development, to reset the inertial system and thus sustain accuracy.

Sperry navigation equipment aboard the *George Washington* includes a hull stabilizer which is a large gyro wheel, 25 feet in circumference and weighing 23 tons (casing and accessories double its weight to approximately 46 tons), which steadies the submarine against sea roll; the transistorized master NAVDAC computer; a Navigation Control Console which is a control panel that ties all systems together; and, Automatic Depth and Course Keeping Controls and instrument panels similar to an airplane's autopilot.

In June of 1959, Sperry Gyroscope was appointed Navigation Systems Manager for the second generation class FBM submarine under a multi-million dollar contract.

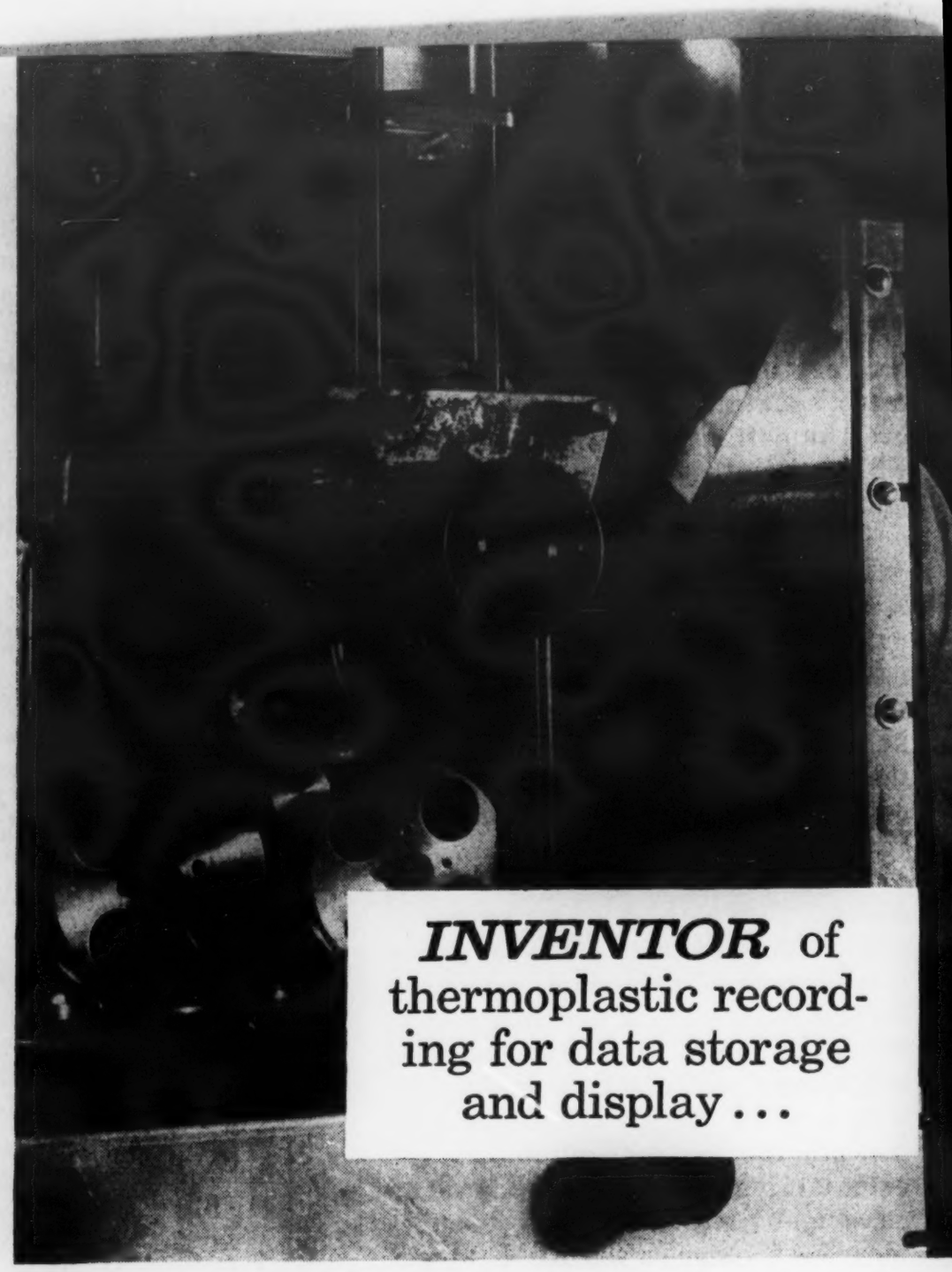
• ***Submarine Communications***

Radio communication with submerged submarines has been possible for a number of years. The systems used have been devised with special care to protect the location of the submarine and leave the advantage of concealment unimpaired. According to the Navy, recent tests have demonstrated that the Navy's world-wide communication system has the power and coverage necessary to exercise command of the always-submerged FBM submarines.

It is commonly known that submerged submarines can receive VLF radio waves at depths great enough for the submarine to remain unde-

(*Continued on page* 18)

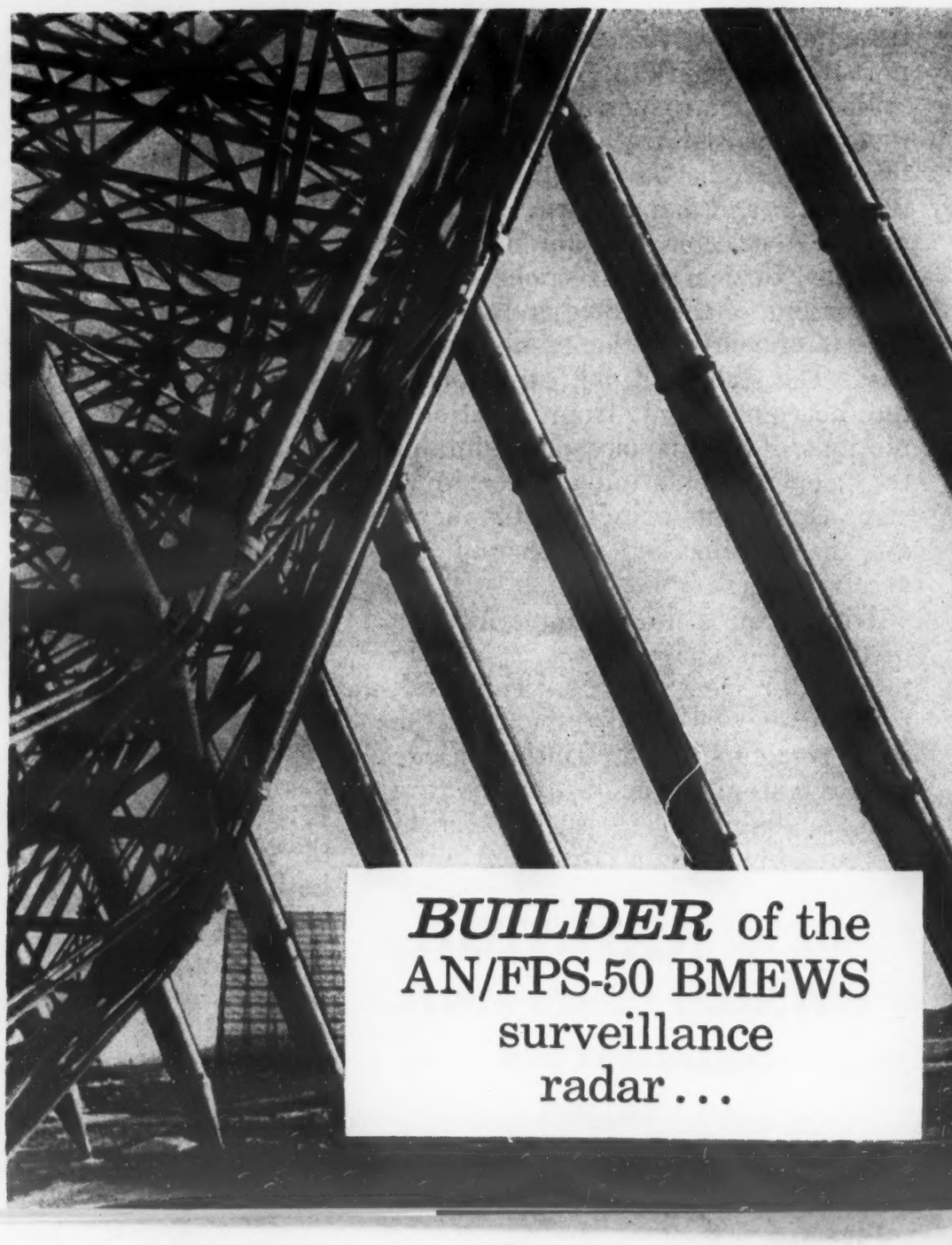
INVESTIGATOR into new methods of sonar signal processing . . .



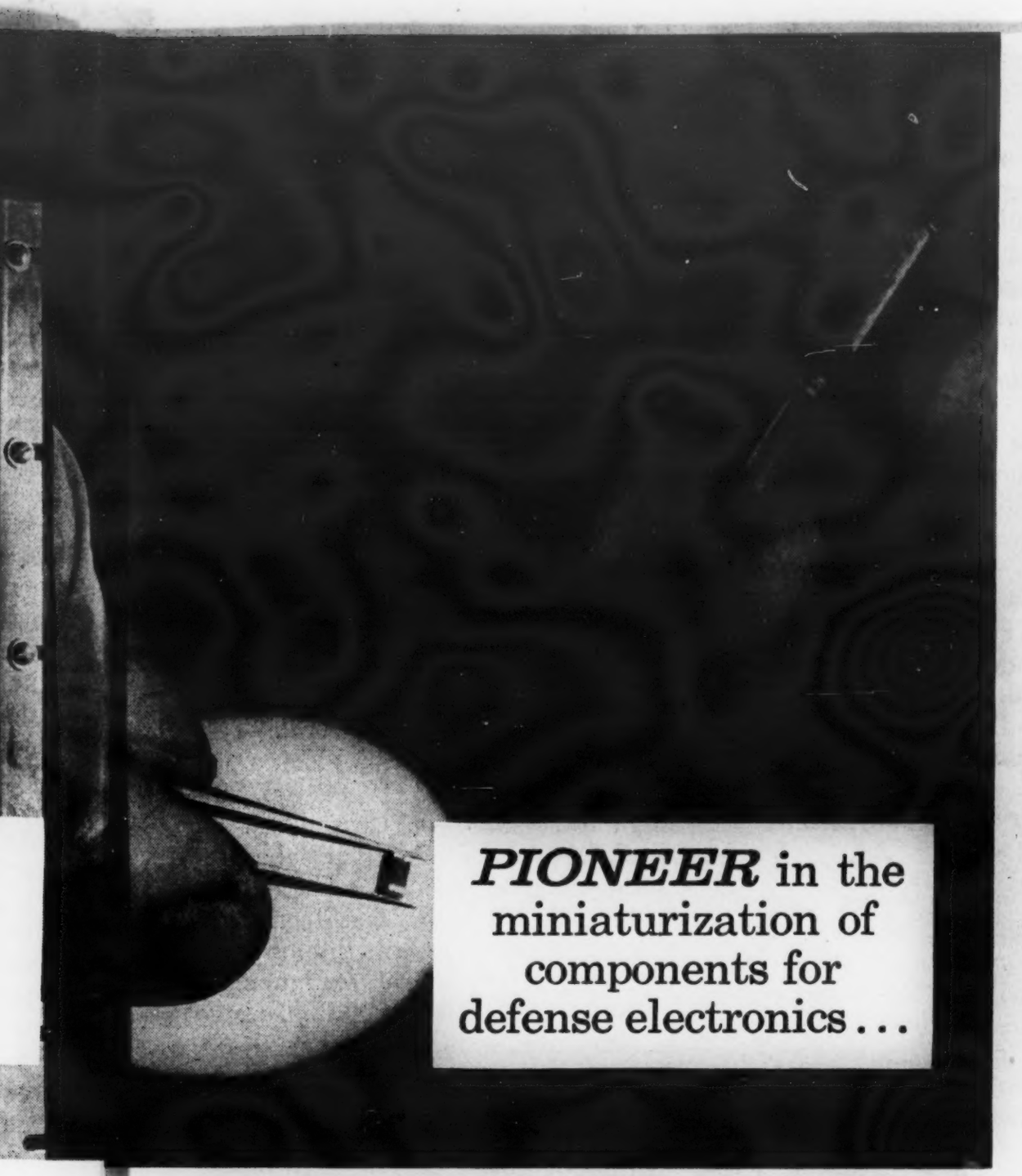
INVENTOR of thermoplastic recording for data storage and display . . .

The Many

CONSTRUCTOR of the first fully automatic 3-D radar data processor . . .



BUILDER of the AN/FPS-50 BMEWS surveillance radar . . .



PIONEER in the miniaturization of components for defense electronics . . .

DEVELOPER of parametric amplifiers for improved radar reception . . .

Roles of HMED*

LEADER in the development of height-finding radars . . .

**General Electric's Heavy Military Electronics Department*

Seven examples of the roles that General Electric's Heavy Military Electronics Department is playing in contributing to U.S. defense strength are illustrated here. Of course, the full spectrum of HMED activities is much broader. It includes work in radar, sonar, missile guidance and control, and computers; in data handling, communications, counter measures, and ground warfare; in air defense, missile defense, and product service. 176-10

Progress Is Our Most Important Product

GENERAL ELECTRIC

DEFENSE ELECTRONICS DIVISION, SYRACUSE, N. Y.

tected. Attenuation is on the order of 1.5 db per foot of depth, an indication of the power required to communicate with deeply submerged submarines by VLF radio waves. At present the Navy has VLF transmitters located in Hawaii, Canal Zone, Maryland, Washington and Maine plus a Japanese VLF station leased to the Navy when required. The Jim Creek transmitter located near Seattle has a 1.2 megawatt power and has been operational since 1954.

The VLF Cutler, Maine Station, which began operational testing last month, is the most powerful Navy radio voice existing. On Jan. 4, 1961, a year in advance of the originally scheduled on-the-air date, the first message was sent from the newly completed 2,000,000-watt transmitter. The transmitter consists of four 500 kw air-cooled power amplifiers. It possesses duplicate exciters, duplicate intermediate power amplifiers, and duplicate power supplies. The giant power amplifiers have individual rectifier-fitter units. Electrical power is generated on the station. The power plant consists of four 2.750 kw diesel-electric generators with two 500 kw generator exciters. Two of the generators provide enough power to operate. Four are required for de-icing.[3]

The Cutler Naval Radio Station cost approximately $70 million—much of the money covering acquisition of a 2,850-acre peninsula in Maine. The prime contractor for about $50 million of this work was Continental Electronics Manufacturing Co. of Dallas, Tex. In all, some sixty government contracts with various firms were required for completion of the powerful radio transmitter station, according to the Navy.

Major contractors for FBM submarine communications systems are Sylvania Electric Products, Buffalo, N. Y.; Princeton Laboratories, Radio Corporation of America, Princeton, N. J.; Bell Telephone Laboratories, Whippany, N. J.; and, ITT Federal Laboratories, International Telephone and Telegraph Corporation, Nutley, N. J.

• *Submarine Propulsion*

The first two classes of Polaris submarines are driven by steam turbines powered by water-cooled nuclear reactors. The use of these reactors enables the submarine to operate for prolonged periods submerged without refueling or recharging its batteries. The reactors used in the *George Washington* and *Ethan Allen* classes are similar to the ones used in the *Skipjack* and *Nautilus*. The *George Washington's* nuclear reactor, it is believed, will have a longer life than the similar reactor which powered the *Nautilus* more than 62,000 miles.

Westinghouse Electric Corporation, Pittsburgh, Pennsylvania, is a major contractor for the propulsion system. The nuclear reactors for the FBM submarines were designed and developed at the Westinghouse-operated Bettis Atomic Power Laboratory in Pittsburgh, under the direction of and in technical cooperation with the Naval Reactors Branch of the Atomic Energy Commission.

• *Missile System Development*

Lockheed Aircraft Corporation, Missile and Space Division, Sunnyvale, California, is the missile system manager and prime contractor for the Polaris missile. In this role, Lockheed coordinates the over-all design, research, development and test programs for the missile. In addition to coordinating these programs, LMSD is responsible for development of the missile frame and re-entry body. Lockheed has subcontractors who perform much of the missile work, under the supervision of its Missile and Space Division. Major contractors working on the missile are Aerojet-General Corporation, for propulsion; General Electric Company, Hughes Aircraft Corporation, and Massachusetts Institute of Technology, for guidance; Nortronics Division of Northrop Corporation, check-out readiness equipment. Other contractors performing work on the missile system include Westinghouse Electric Corporation, launching.

"You have rightfully earned a personal share in this glittering achievement as a member of the superb Polaris team." These words, spoken by Special Projects Office Director Vice Admiral Raborn, were contained in commendation certificates presented to 9,000 Lockheed Aircraft Corporation employees and suppliers who played an important role in joining the 1200 n.m. missiles to the first ballistic missile submarine, the *George Washington*, November 15, 1960. On this date, three years ahead of schedule, the missile and its submarine became operational and set out to sea to provide a powerful deterrent to any aggressor.

The Polaris missile is a solid propelled, inertially-guided ballistic weapon capable of being launched from submerged or surface nuclear submarines and from surface ships. The length of the A1 missile, to be used in the first class of FBM submarines, is 28.5 feet; its diameter, 54 inches; its weight, 28,000 pounds. The A2 and A3 missiles are of the same general appearance but a little longer than the A1.

LMSD conducts the flight test program for the Polaris missile under the supervision of the Special Projects Office. Tests are made on the general missile development, guidance systems, re-entry body development, arming and fuzing, as well as first and second stage motor performance and missile control action during powered flight. Testing is done at the Air Force Missile Test Center, Cape Canaveral, Florida.

As of November 1, 1960, over fifty flight tests had been carried out on the 1200 n.m. missile during the preceding thirteen months. These tests include twelve launchings from submerged nuclear powered submarines, plus four other underwater launches.

Flight tests of the 1500 n.m. range missile began in November 1960. Work has begun on the 2500 n.m. missile, expected to be operational in 1965, and flight tests of this missile will begin later.

Lockheed began its work on the missile in 1956 when LMSD was awarded a missile study contract. Later that year, LMSD received the development contract for the missile. In October 1960, a few weeks before the 1200 n.m. range missile was ready for Fleet use, the Navy awarded LMSD $181 million to speed development of longer range versions of the missile. The 1961 fiscal year extension of Lockheed's Polaris research and development contract brings to approximately $608 million the funds awarded to Lockheed for Polaris research and development since 1956. In addition, prior to July 1, 1960, the Navy had awarded Lockheed $490 million for production of flight test vehicles and initial orders of tactical Polaris missiles and associated hardware. Miscellaneous supporting services such as training of Navy personnel and technical management of the Navy's Polaris final assembly and issuing facility accounted for another $5.5 million.

• *Missile Guidance*

The inertial guidance system for the Polaris missile is a refinement of earlier inertial systems and is the smallest system presently in use in any operational United States ballistic missile. The guidance system puts the missile on correct course at the

(*Continued on page* 20)

[3]U. S. Naval Institute Proceedings, "*How It Works—VLF Communications,*" *by Lt. Wm. D. Hart. September 1960.*

RECONNAISSANCE, THE LACK OF IT, AND A FAULTY COMMAND DECISION

The year is 1862. The Army of the Potomac, 70,000 men in blue, is primed to do battle. Facing them, General John B. Magruder's divisions of the Confederate Army of Northern Virginia firmly entrenched before Richmond, but numbering only 15,000. The sheer weight of Federal men and equipment apparently is sufficient to gain the victory, destroy the Southern force, capture the Confederate capital and perhaps end the war.

But General George B. McClellan, the Union Commander, never orders the advance. Why?

During the years preceding the war, adequate provisions for reconnaissance had not been made. McClellan's intelligence, directed by the famous detective Allan Pinkerton, overestimated the strength of the Confederate forces . . . *overestimated those forces to be twice those of the Army of the Potomac.* During this early phase of the War, Union reconnaissance cavalry is too inexperienced and limited in number to verify this civilian intelligence. And so this singular Union opportunity slowly ebbs—dissolving into three more years of bloody warfare . . . the result of a faulty command decision.

From the beginnings of communities on the face of the earth, reconnaissance has helped shape history. Today CAI's specialty in this area is helping shape history to the advantage of the Free World. Typical of CAI contributions are: **V.I.P.** Visual Integrated Presentation, data display system; **KA-30** the world's most versatile aerial camera; **SOLO** the only electro-optical "available now" guidance system.

CHICAGO AERIAL INDUSTRIES, INC.

550 WEST NORTHWEST HIGHWAY, BARRINGTON, ILLINOIS • offices: DAYTON, LOS ANGELES, WASHINGTON, D.C.

OTHER DIVISIONS: KINTRONIC, CHICAGO AERIAL SURVEY, Franklin Park, Illinois; PACIFIC OPTICAL CORP., Inglewood, Calif.

time of launch. Should the missile be moved off course by high winds or other effects after it has been launched, the guidance system automatically computes a new course and puts the missile on it. Then at the precise instant required, the guidance system shuts off the rocket motors and triggers separation of the re-entry body from the missile. The guidance system works with the thrust termination device in the propulsion system. The re-entry body then follows a ballistic trajectory or path to the target. The guidance system uses precise gyroscopes, accelerometers and its own electronic computer.

Polaris is the only operational ballistic missile using solid fuel that has an inertial guidance system.

The three contractors performing work on the guidance system are the Massachusetts Institute of Technology, Cambridge, Massachusetts; General Electric Company, Ordnance Department, Pittsfield, Massachusetts, and Hughes Aircraft Corporation, Culver City, California.

The Instrumentation Laboratory of the Department of Aeronautics and Astronautics at the Massachusetts Institute of Technology designed and developed the inertial guidance systems. The Mark I inertial guidance system is being used in the 1200 n.m. missile and 1500 n.m. missile and the Mark II inertial guidance system now under development will be used in the 2500 n.m. missile. The Mark I guidance systems are manufactured to M. I. T. design by General Electric's Ordnance Department and by Hughes Aircraft Corporation.

Laboratory work on the development of the Mark I guidance system started in 1956 under a prime contract from the Navy. The fact that the Polaris missile is launched by an all-dimensional mobile platform, a submerged submarine at sea, imposes unusual design and production challenges not presented by missiles launched from a fixed land base. Beyond this, Polaris offered particular problems because of its comparatively small size, 28 feet, and because it is propelled by a solid fuel motor. Despite these problems, all schedules were met in the guidance development program. Throughout the design and development phase, the Instrumentation Laboratory maintained close liaison with the contractor producers in order to insure earliest possible production of the guidance systems.

The Mark II guidance system for the 2500 mile missile will be lighter, more reliable and more accurate than the Mark I system, M. I. T. believes.

• *Missile Propulsion*

The two-stage Polaris missile is powered by rocket motors containing solid fuel. Each motor exerts thrust through four nozzles in the motor base. The propellant used in the motors is a polyeurethane compound that contains metal additives for higher specific impulse. The thrust vector, or direction control, is exercised by steering devices called jetavators. The jetavators direct the flow of the gas stream from the rocket chamber.

Aerojet-General Corporation of Sacramento, California, has designed, developed and is producing the first and second stage propulsion systems for the operational 1200 n.m. range Polaris missile. A subsidiary of The General Tire and Rubber Company, Aerojet also is doing work on the first stage propulsion system for the 1500 n.m. Polaris A2 missile. Hercules Powder Company of Bacchus, Utah, is producing the second stage propulsion system for the 1500 n.m. missile. Work also is proceeding with propulsion research for the 2500 n.m. Polaris by both Aerojet and Hercules.

Within three years, technical achievements made at Aerojet's Solid Rocket Plant enabled the Polaris missile to do three vital things which had previously not been possible for a missile using solid propellant. First, Aerojet scientists improved the energy level of solid fuels to give Polaris the required 1200 and 1500 n.m. ranges. Earlier solid fuel missiles could travel less than 100 miles. Second, Aerojet designed and developed a system of jetavators for steering which has proven successful with high flame temperatures over 5,000 degrees Fahrenheit. It was recognized that Polaris would need to have a steering device capable of withstanding heating equaling or surpassing that experienced by missile re-entry vehicles. Third, Aerojet developed a successful thrust termination device. This device shuts off the missile's thrust, thus enabling the weapon to hit any one of several possible targets along its flight path.

In 1960 Aerojet developed a new process for producing a more uniform quality solid propellant. This production process is called continuous mixing. By this process small quantities of the propellant ingredients can be carefully measured and continuously mixed, insuring greater safety than was possible by using the "Batch" method in which large quantities of the propellant were mixed. The new method also costs less than the old method.

Numerous tests have been conducted on the rocket motors for the 1200 n.m. missile. A test facility at Sacramento contains a quality control device enabling engineers to "see" the internal structure of solid rocket motors in more detail than had been possible previously. Aerojet worked with the Navy to develop and put into use this device which is based on gamma radiation given off by cobalt 60. The company says that very small flaws may be detected inside rockets several feet in diameter.

In addition to the gamma scintillation inspection, Polaris motors are also examined with ultrasonic devices to check the bonding of propellant liner to the steel shell. The motors also are put through x-ray examinations. A separate inspection of the fore and aft heads is made with a "camera," which utilizes a 1000 Curies radioactive cobalt source. This "camera" produces x-ray films which show any possible faults in the insulation and liner system. Successful static test firings of Polaris motors which had been on the shelf for nearly two years proved the storability of solid fuel.

The first stage rocket motor which Aerojet is producing for the 1500 n.m. missile will be longer than the motor used in the first stage of 1200 n.m. missile, and the weight of the motor case and other non-burning parts will be several hundred pounds less than the total weight of non-burning parts for the first stage of the 1200 n.m. missile, Aerojet believes. The added length and reduced weight will help the missile travel the additional distance.

• *Missile Checkout*

Although many tests have been made on various parts of the missile prior to its installation aboard the submarine, it is necessary to keep checking on the weapon right up to the time of firing. Digital Automatic Tape Intelligence Checkout (DATICO) is the system used for this purpose. Connected to the various subsystems of each of the sixteen missiles through the fire control switchboard, the system performs three types of checkout tests on the missiles: a continuous monitoring of certain missile subsystems from the time the missiles are loaded on the submarine; a periodic maintenance check to make sure the launch and flight control systems are ready to function properly; and the final countdown check at the time of firing.

DATICO system was developed by the Nortronics Division of Northrop Corporation, Anaheim, California,

(*Continued on page* 25)

MANAGING OUR RESOURCES FOR DEFENSE AND GROWTH

by GEORGE F. METCALF
Regional Vice President
General Electric Company

IT APPEARS TO ME THAT the ever accelerating growth of science and engineering, and particularly electronics and space science, is one of the most important factors, if not the dominant one, that triggers the many social and political changes in the world today. As we look back in history to its first recorded beginnings, we see the impact of agriculture causing the first development of stable civilization. A few thousand years later we see the industrial revolution bringing better living to Europe and changing its entire social structure. During the last twenty or perhaps fifty years it seems to me that we are the very beginning of what I might call the science revolution. I am using the word "science" here to cover all who are both seeking and applying new knowledge.

Those of us concerned daily with scientific and technical progress do not always have the time, nor take the time, to look at this fundamental change in the proper historical prospective. Consider, for example, the growth of technical publications. A recent study in England shows that the number of scientific and technical journals in the world has doubled every twelve years since the year 1700. I am noting not the size of the journals, but that the number of separate, independent technical periodicals has doubled every twelve years since the year 1700, and there is every indication that this rate will continue for sometime to come. On the other hand, world population now doubles approximately every fifty years, and at the beginning of this time period it took almost 100 years to double. Technical publications are then increasing four times faster than the population growth. At the same time those men and women who generate these published papers are growing at an accelerated rate also. Since the year 1900 the proportion of men and women with college degrees to the total population reaching age 22 is increasing by 50% every ten years. Eight times as many young people receive college degrees as they did in the year 1900. These people are daily adding to the vast reservoir of technical knowledge contained in our present thousands of technical journals and books. Equally important is the information contained in the minds of those working in these growing fields.

Another significant fact is the type and depth of education that our young people are receiving today. They are being educated on the basic fundamental facts of nature which do not change with time and not, as often as happened in the past, educated on how to build or operate a machine which usually was obsolete before they completed their training. They had little understanding of what made the machine operate. Sometime ago I had the opportunity to visit one of the large major universities in the east and found that they had just finished a complete revision of their electrical engineering curriculum. They literally cleared out their shops and laboratories of the old motors and generators and switched instead to clean-top laboratory benches which allowed demonstration and experiments in the basic facts of physics and electricity.

The academic staff had taken part in and contributed substantially to the march of developments during the last few years. They saw clearly the futility of teaching their students the circuit diagram of a radar receiver or the thickness of insulation required on a motor when new insulating materials were being developed every year and parametric amplifiers were increasing receiver sensitivities several fold.

Most college students today spend their "midnight oil" on the imperishable facts of engineering that they can profitably employ for their entire professional career. The effects of

such training accelerate development of new knowledge as much as an automated factory accelerates production.

Our improved education goes back even further—to high schools and even to elementary education. Most of you have experienced penetrating questions from the high school students as to the orbit of satellites or the effects of radiation pressure.

This reservoir of human knowledge always growing, and rarely lost, is being added to in ever increasing amounts. In recent years a further acceleration has been furnished by the government or more realistically by the public's interest of its importance. Even though most of us spend a sizeable proportion of our time trying to increase public understanding, and certainly this is most necessary, the fact remains that in the last ten years, and at most the twenty years since World War II, the public as represented by our government has placed a totally different value on our work. Consider the 6 billion dollars appropriated by Congress for Research and Development in the area of national defense. And the 1 billion for the exploration and use of atomic energy, and the 1 billion dollar budget for space exploration; a total in these three fields alone of 8 billions of dollars. Not since 1948 has the nation's research budget been smaller than in the preceding year. A study by the National Science Foundation indicates that our government's Research and Development budget for fiscal '61 has increased nearly a hundredfold over that of 1940 and most importantly these increases are not due to bureaucratic or "pork barrel" spending but due to the realization that factual scientific knowledge is playing an increased part in the lives of all of us.

Three New Patterns

I am sure that I need not dwell further on the fact that a major change has taken place in, not only our country, but the world. The important factor is, what are its consequences? Can we in some small way at least look forward as well as backward? I think we can see some broad trends.

First, new products and new ideas become useful and reach maturity far faster than ever before.

Second, each major step is bigger.

Third, the products resulting become increasingly more complex.

Let us look at each of these in turn and see if they can aid us in planning for the future.

First, the time from the first practical use of a new product which is based upon new technology until it reaches its full stature in the economy is decreasing. Even after it reaches its full peak use it usually does not die but finds a niche where it plays a secondary, though essential role. Radio receivers, for example, were not superseded by television, but were placed in a supporting position. The tank was not superseded by the airplane nor will the ballistic missile supersede the airplane. Each is building upon the base of the other, each contributing to our economy and comfort or to our security. Each development is reaching fruition sooner than the last.

Secondly, each step involving a basic discovery seems to have a bigger impact than the last. Some time ago I took part in a study which analyzed and endeavored to forecast products and activities in the field of electronics. We found that products introduced prior to 1910 account for only 3% of our present national production and in each decade the amount doubles. These products introduced from 1910 to 1920 gave us 7%. The roaring 20's, or better described as the "radio era," account for 15%. In the 1930's products were introduced which are nearly 30% of our today's market. Then came the television, radar and computer of the 40's with nearly 65% of today's markets. In the decade just past definitive data is not available but there is little doubt that the trend has continued. The developments in each ten-year period seem to contribute about twice as much as those in the preceding decade. This explosive growth also exists in other fields. It has occurred in aeronautics, and it followed with our ability to split the atom, and now we have space exploration for the decade of the 60's. Certainly it offers larger promise than any past development. Truly new worlds are to be explored.

The third pattern is one that has particularly deep significance. The primary steps in this continuous growth are made up of products requiring increasingly larger amounts of diversified human effort for their production and for their application. A radio receiver is followed by television, certainly a big step in complexity, but then by radar, next by digital computers with literally millions of carefully integrated and delicate parts, and today these are followed by the nationwide teams required to launch a satellite and recover its payload from space.

Challenge to Technical Conquest

Here, I believe, lies the challenge, even perhaps the limit to continued acceleration of man's technical conquest. Here the *lack* of clear planning, sound objectives, and well measured steps can create waste, inefficiency such that we will lose most of what we are gaining through education, through effective use of accumulated knowledge, and other great strengths of our society.

We are meeting the scientific and technical challenge—but are we meeting the challenge of efficient team play? What steps are we taking to measure effective performance in the large R & D programs?

This job of maintaining efficiency, yet producing the largest and most complex defense systems that man has conceived, is often misunderstood. It can be, and often is, the finest example of America's free enterprise system, utilizing both small and large industry: the system which has made our country the unquestioned leader in the world's civilian economy. The Soviets may question our military power, as we sometimes do, but they always set their sights on our non-military achievements. To maintain this efficiency, the key factor is the development and effective use of true measurements of performance. When we measure our performance and properly reward good work and penalize poor work we need have little concern as to limits on our growth.

New Yardsticks Needed

When the Army buys a hundred thousand standardized and proven rifles, the measurement can be largely the price bid by several qualified suppliers. But when you buy innovation and new technology, perhaps a new missile system, we need new yardsticks to make measurements of performance meaningful. When you buy a new automobile for your personal use, you consciously and, in fact, subconsciously weigh a multitude of factors—price, quality, the manufacturer's reputation, and numerous others, and when six million people do this each year it results in our automobile manufacturers being measured and rewarded by the world's most effective system. We have a long way to go to develop equally efficient measuring systems to apply to those supplying today's complex weapons systems. Large businesses and small business realize full well they must be efficient to prosper and grow, but all too often they have no mechanism to measure

(*Continued on page* 49)

COMPUTENCE . . . TOTAL COMPETENCE IN COMPUTATION

. . . provides effectiveness for new system of mobile defense against multiple airborne targets

The program: MAULER, U.S. Army's newest automatic-firing air defense system, involving missile-firing vehicles transported by air and parachuted into battle areas. **Basic Burroughs contribution:** design and production of the miniaturized electronic computer systems which will provide radar data processing and computation for MAULER. Among special design features will be the Burroughs Logi-Mod packaging technique, to protect sensitive computer components from shock during air transport and parachute drop. **Behind the news:** Still another vote of confidence in Burroughs Corporation's Compútence—total competence in computation—from basic research through production and field service to system management. Confidence in Burroughs performance, already proved in such vital programs as ATLAS, SAGE and ALRI.

Burroughs—TM

Mauler is being developed by Convair-Pomona, Convair Division of General Dynamics, for ARGMA, an element of the Army Ordnance Missile Command.

Burroughs Corporation

"NEW DIMENSIONS / in computation for military systems"

AFCEA'S ROLE IN THE CIC

RAY E. MEYERS
Chairman
Southern California CIC
and
AFCEA Regional Vice President

IF YOU FAILED to digest the information in last month's issue of SIGNAL on the necessity of controlling radio frequency interference, re-read the article prepared by George Turner, Chief of FCC's Field Engineering and Monitoring Bureau. George, a member of the Washington Chapter, has pointed out the need for industry, guided by such national organizations as AFCEA, to assist the Federal Communications Commission, and the general public in the continual fight to suppress radio frequency interference.

AFCEA with some 55 chapters scattered throughout the world is in a fine position to pick up the ball and sponsor Cooperative Interference Committee groups especially when it is considered that we, as a national society of United States citizens working toward national security in the fields of communications and electronics have dedicated ourselves to maintain and improve the cooperation between the Armed Forces and industry in the design, production, maintenance and operation of such equipment in time of peace as well as in time of war.

Communication equipment, whether it be voice, teletype, telemetry, facsimile, video or missile control is subject to interference and we of AFCEA should ever be mindful of the serious results it could create in this modern "Push-Button" era in which we live. Certainly our design engineers, scientists and technicians take every known precaution to develop equipment which will not emit spurious emissions, harmonics, and other unwanted RF radiations, but these radiations continue. It might be a cracked crystal, a poorly soldered joint, a faulty antenna system, a thermostat that failed, an electric blanket, fish bowl heater, butter conditioner, oscillating receiver, or some other piece of equipment. In spite of the care of our design personnel, many things happen to cause a commercial airliner or military aircraft to crash, a man o' war to run aground or collide with other vessels, a missile to turn right or left when it is planned to head for the moon, or Aunt Minnie's TV receiver to pick up some Public-Safety radio calls instead of Amos and Andy.

How CIC Works

How can we help. As one of the originators of CIC I'll tell you. It takes teamwork by a lot of men like those who make up AFCEA. Whether you be a president, chief engineer, scientist, technician or sales engineer, an admiral, general or specialist first class, you should be interested in knowing if your equipment is functioning properly. That's where CIC will click. Cooperative Interference Committee is an organization, in the form of local committees of well qualified persons interested in any form of communications or electronics services, willing to devote a little time in a project of public service nature.

CIC works in the following way. The minute one of our members is faced with a serious case of interference, we determine, or surmise the source of the interference—whether it be power line, aeronautical radio, public-safety, broadcast, or other source. Next, we make a quick call to a CIC member engaged in that particular field of interference work, and within a short period, in most cases, the RFI has ceased. Usually a phone call is returned by some thankful person who appreciates being called stating that had the interference continued his organization might have been faced with an expensive repair bill, a possible fire, or even an FCC citation. Best of all, the nuisance, or damaging RFI is eliminated and business goes on as usual.

To get a CIC started takes but a few hours, a carefully worded letter, a printed form that the recipient can quickly check off and sign, and some industrial benefactor willing to print a directory for distribution to each of the volunteers affiliated with the group. National Headquarters has copies of the initial kick-off letter sent to the management of every known communications and electronics company in the Southern California area, as well as the self-addressed return letter and check off list which was to be returned to the chairman by those wishing to participate. Please contact National Headquarters for copies.

CIC Directory

The directory can be simple in format, or elaborate in detail. Our directory in the Eleventh Radio District contains five lists: alphabetical by members' names, agencies participating, amateur participants, field of interest and geographical locations. In addition, Albert T. Parker, President of A. T. Parker Associates, a professional group engaged in the location and suppression of RFI, has written an appendix giving an explanation of interference. We have outlived two directories, the first of which was printed by Hopkins Engineering, and the second by Stoddart Aircraft Radio Co., Inc., two well known firms engaged in the suppression and detection of RFI. A third directory is in the planning stage and already two Southern California electronics firms are willing to take on the job. When printed, each Field Office of the FCC is provided a copy of the directory and should your chapter like to look it over, check with your local Field Engineer.

AFCEA, with chapters located in the important electronic centers of the country, is in a wonderful position to sponsor local CIC groups. All it takes is chapter action, a request for a volunteer to start the ball rolling, selection of an ad hoc committee to dig into the details, a meeting with the local Field Engineer in Charge of FCC's office and the show is on the road.

(**Editor's Note**: *In order to acquaint our readers with the work being done by Cooperative Interference Committees,* SIGNAL *is publishing the following CIC reports which show how interference was eliminated in three instances.*)

Alabama CIC

Lucien C. Bomar, Chairman of the Alabama CIC, received a report from a communications service company concerning a strong transient type of pulse with an irregular but frequent repetition rate, which was interfering with the radio systems being operated by several of their clients in the 40-50 megacycle range. The mo-

(*Continued on page* 34)

Polaris

(*Continued from page* 20)

which received the prime contract for the missile checkout system in 1959. The basic DATICO consists of a programmer-timer with an integral punched-tape reader, control scanner, program board module, test point selector, digitizer, comparator, indicator and control tape magazine and printer. In addition to supplying the checkout units for use aboard the submarines, Nortronics is providing DATICO systems for use on the submarine tenders and at the Naval Weapons Annex, Charleston, South Carolina, where the missiles are received from production lines and checked prior to issuance to the submarines.

• *Missile Launching*

Polaris missiles are launched by an air ejection system which forces the missile from its launching tube and propels it up through the water to a point above the surface. At that point the rocket motor ignites and sends the missile on its way. The system takes advantage of the reliability and instantaneous ignition characteristics of the solid propellant fuel used in the missile. Each of the sixteen missiles within the submarine has its own vertical launching tube and air supply, and each tube is independent of the other fifteen.

The launching system was designed and developed by Westinghouse Electric Corporation, Sunnyvale, California. In operation, the system permits the submarine to fire the missile from a submerged position undetected by radar, Westinghouse believes.

• *Supporting Facilities for Submarine and Missile*

Support facilities include missile testing sites, Naval Shipyards, submarine tenders, an experimental test firing ship and a navigational test ship.

Chief testing site is the Atlantic Missile Range, Cape Canaveral, Florida. The Navy complex includes three launching pads, a missile assembly building, missile check-out building, engineering building and associated supply and maintenance buildings and shops. Two of the launching pads are conventional flat pads and the third is the unique ship motion simulator which mounts a submarine type launching tube in a 200 ton hydraulic device that can simulate all the motions of a ship at sea. The first test vehicle launch from this device, using compressed air to eject the missile and firing its rocket motors above ground was made August 14, 1959. The test vehicle achieved all its objectives.

USS Observation Island (EAG 154), experimental missile test firing ship, is based at Port Canaveral, Florida. The ship, a post World War II Mariner class cargo ship modified extensively to serve as a firing test ship, has a complete submarine type fire control, navigation and launching system. The ship serves as both a floating launch complex for missile flight testing and as a working example of the kind of installation which could be placed aboard surface ships. *Observation Island* has served the additional role as floating school for training FBM submarine crews and will be the seagoing link between the Atlantic Missile Range and FBM submarines when they visit the Cape for training with live test vehicles.

Flight tests of Polaris missiles are conducted at Cape Canaveral. Other tests on various parts of the missile have been conducted at Naval Ordnance Test Stations.

A Naval Weapons Annex has been commissioned to serve as a missile assembly and loading point. Here completed sections and subsystems of the missile, including motors, controls, guidance and so on, are being received from contractor plants, assembled, checked out and stored or loaded aboard FBM submarines.

The submarine tender, *USS Proteus* (AS 19) has been commissioned and will be able to provide supplies, service and all but major repairs to the FBM submarines. This includes supplying missiles and loading them into submarines. A second tender, yet unnamed, is under construction.

• *Instrumentation*

Interstate Electronics Corporation of Anaheim, California, a subsidiary of Interstate Engineering Corporation, is responsible for the design, development and fabrication for range instrumentation for use in testing of the Polaris weapons system. Test instrumentation facilities have been completed for land and shipboard tests and are now being used successfully aboard the Polaris submarines. An estimated nine tons of electronic and photographic equipment designed and built by Interstate Electronics Corporation is installed on board each FBM submarine during its missile firing training and test period. At the end of the period, this equipment is removed for installation on the next submarine scheduled for firings on the Atlantic Missile Range.

Test and evaluation instrument systems provided by Interstate are located in three separate areas: shore launch site; support instrumentation ship; and, submarine. Each functions as a separate system, integrated by a firing-range communications network. The over-all system provides a complete record of a missile test firing for later evaluation.

Range-site instruments include a complete telemetry system and a launch complex environmental measuring system. They are installed at the Atlantic Missile Range as is additional equipment for inspection and data reduction. Launching operations from the *Observation Island* are supplemented from the Atlantic Missile Range by providing range safety and flight telemetry recording facilities. The *Observation Island* may assist when test launchings are made from a submarine.

All test and evaluation equipment installed in the submarine were designed for easy access and removal. When the submarine completes a series of tests, the evaluation system is removed and installed into another submarine.

Two submarine systems are utilized. Seven subsystems comprise each submarine test and evaluation instrument system and are counterparts of similar subsystems aboard the surface ship and the supporting range station. These subsystems are: Timing and Control; Launch Complex; Telemetry; Communications and Checkout; Photographic; Fire Control Photographic Recording; and, Digital Recording and Ship's Function Processing. The subsystems are used during five operational phases: Timing correlation before launch; Missile checkout before launch; Launch and underwater trajectory; Post launch; Post initial air trajectory.

The *Timing and Control Subsystem* generates correlated timing signals for all recording equipment in the instrumentation system; provides programmed control for the recording equipment; provides facilities for informing the instrumentation supervisor of all subsystems' status; and, provides countdown time information for the system, the missile control center and the ship's control center.

The *Launch Complex Subsystem* measures and records physical phenomena such as strain, pressure, displacement and so on associated with the Polaris launching. The subsystem records the time of the occurrence of events taking place during the launching.

The *Telemetry Subsystem* relays r-f telemetry signals from the missile to the ship and records pre-launch signals.

The *Communications and Check-out Subsystem* provides communications within the submarine and between the submarine and the support facility. Signals to and from the submarine are received and transmitted through an antenna system mounted on the submarine's sail.

The *Photographic Subsystem* provides film coverage of the ascent of the missile through the water. Four 16mm motion picture cameras record the action at 90 frames per second. Two similar cameras, operating at 45 frames per second, cover the remainder of the water ascent.

The *Fire-Control Photographic Recording Subsystem* provides a permanent record of certain dynamic and static quantities displayed on panels of the fire control equipment before, during, and after a missile launching. Remote operated camera assemblies are employed.

The *Digital Recording and Ship's Function Processing Subsystem* is provided primarily to monitor functions in the navigation and ship systems. The navigation quantities are digitally recorded on magnetic tape. Some of these data are processed by analog-to-digital conversion equipment, while others are received as digital signals directly.

Polaris work completed by Interstate Electronics Corporation has totalled $12,600,000 and Polaris work for the current year totals approximately $3,300,000. All of Interstate's Polaris contracts were awarded by either Navy's Bureau of Ordnance or its successor, the Navy Bureau of Weapons. The first contract was awarded in September of 1956.

III. PERT System

The Special Projects Office has the responsibility for the technical direction and management of the complex FBM program. As an aid in carrying out this task, SPO has devised a new technique for the management and evaluation of the research and development effort for the Polaris weapon system. Called Program Evaluation and Review Technique (PERT), this system is a management control tool for defining, integrating, and assessing what must be done to accomplish Polaris program objectives on time.

The PERT system can simulate the effects of alternate courses of action for a particular subsystem as well as their impact on the over-all objective prior to technical or management decision. Efficient operation of any evaluation system is dependent upon timely receipt of accurate information. PERT is designed to obtain the necessary information rapidly and with minimum effort, and through use of an electronic computer rapidly disseminates the outputs to all levels of management in the complex FBM program.

PERT performs various functions. With the aid of an electronic computer, PERT reports progress against approved plans and scheduled program objectives, the outlook for meeting ultimate objectives on time, and delineates potential problem and slack areas for management action. PERT measures the relative uncertainty for accomplishing activities that link events in the network—based on technicians' estimates of time and range of time necessary to complete each activity. PERT computes the current probability for meeting scheduled completion dates, based on the comparison of current expectations with scheduled dates. Probably the most important function that it performs, in addition to providing management with the integrated, summary picture of total progress and progress outlook on a continuous basis, is highlighting the areas of effort requiring management attention and decision and documents planning.

IV. Funding

Funding for the Polaris weapon system is provided for in the President's annual budget. This budget takes into consideration the needs of the Services for their various programs. The budget figure finally decided upon by the President, after consultation with his staff of advisers, is presented to Congress in January for approval. Congress has the responsibility of reviewing and, if it deems necessary, of amending the President's budget request. If the Congress appropriates more money for a particular project than the President requests, the Chief Executive then has the power to withhold or release these additional funds.

It has been said that Congress has provided "the zeal and sense of urgency" and "the initiative that have sparked our most spectacular gains in defense," according to Representative George H. Mahon of Texas. Certainly the Polaris weapon system is a powerful force for the United States' defense. In recent years the Congress has appropriated more funds for the Polaris program than the President has requested. In the budget for fiscal year 1959 (July 1, 1958 through June 30, 1959), funds for the construction of two Polaris submarines were requested by President Eisenhower. Congress added $609 million for an additional four submarines and for other supporting requirements (which would have brought the total number of submarines under construction to nine). President Eisenhower released $309 million of this amount on December 23, 1958. This money included funds for the construction of one Polaris submarine, bringing the total number of submarines under construction to six, and for the development and conversion of a World War II submarine tender to an FBM submarine tender. Then on June 24, 1959, the President released the remaining $300 million for use in fiscal year 1960 for the seventh, eighth and ninth Polaris submarines.

In the 1961 budget, the budget for the current fiscal year ending in June, the President requested funds to complete three Polaris submarines and to start work on three additional submarines. Congress added $394 million above the President's budget for the completion of two additional Polaris submarines and for the procurement of long lead items for four other Polaris submarines. Thus, for fiscal year 1961 Congress requested that five submarines be fully funded and seven submarines be partially funded. Money for these seven was to be spent for long lead time items. The President later approved the revised Polaris Program for fiscal year 1961 calling for the construction of five submarines and long lead time items for five submarines. So the 1961 funding provided for work on ten submarines, five of these are being completelv funded and five others partially funded. The funds for the long lead time items for the remaining two submarines have not been released yet.

In the five full years that the Polaris program and the preceding Navy participation in the Jupiter program has been in effect, a total of $4.2 billion has been appropriated for the Navy. This figure includes all the funds appropriated from fiscal year 1956 when Navy participation in the Jupiter program began with $20.8 million through fiscal year 1961 in which $1.3 billion has been appropriated.

The Navy has provided a breakdown into five categories showing how the money has been spent. The largest portion of funds appropriated, $1.942 billion, is being spent on the shipbuilding and conversion programs. This figure covers funds for

(*Continued on page* 42, *col.* 3)

Extra copies of this special Air Force issue may be ordered by writing to the Editor. $1.00 each, 6 for $5.00, 12 for $10.00.

A reminder to readers and advertisers. The complete story of Air Force communications and electronics will be told in the March issue of SIGNAL. To arrange for advertising space in this special issue, contact William C. Copp & Associates, 72 West 45th Street, New York 36, New York. To reserve your extra copies clip and mail the order form at right.

Colonel W. J. Baird, Editor
SIGNAL
1624 Eye St., N. W.
Washington 6, D. C.

Send ..... copies of the March issue.

Name .....

Firm .....

Address .....

City..... Zone..... State.....

Send bill ☐

Payment enclosed ☐ (Price includes postage)

SIGNAL TRAINING PAYS OFF

by

MAJOR HARRY A. NICOLL, SigC

and

CAPTAIN CLYDE D. MERRICK, SigC

Signal Unit Training Group
U. S. Army Signal Training Center
Fort Gordon, Georgia

"AGGRESSOR ARMY has established beach heads at Brunswick and Apalachicola with airheads at Valdosta and Waycross. He has successfully defended a forward edge of the battle area along a line through Panama City, Tallahassee, Thomasville, Valdosta, Waycross and Brunswick. Your mission is to provide communications in the Georgia Theater of Operations (GATO) down to '100' Army and 'L' Corps whose mission is to attack and seize Waycross, counterattack east and contain the enemy to the West."

The above paragraph from an operation order recently published put into motion one of the largest efforts to date of a true ONE ARMY CONCEPT. This directive brought together Regular Army soldiers of STRAC and 2361 National Guardsmen of the States of Mississippi, Alabama, Georgia, Maryland, Virginia, South Carolina and Kentucky in a magnificent display demonstrating what can be achieved in compliance with former Secretary of the Army Brucker's desire for a "One Army."

As recently as the late Spring of 1959, all these units involved were in branches of service other than Signal Corps. A reorganization directed by the Department of the Army in its continuing program of modernization along lines of the Pentomic Concept brought about these changes calling for more communications. Laying and firing an artillery piece or engineering a military road through dense jungles is a far cry from aligning a VHF system. That year —1959—only three states sent National Guard units to Fort Gordon for training.

Presented with the task of providing a training program for the annual active duty encampment of these National Guard units, the Signal Training Center at Fort Gordon, Georgia, called on the Signal Unit Training Group (SUTG) to provide the necessary assistance and guidance. The Third United States Army is responsible for the training of all troops (active Army and reserve components) within the Army area. The STRAC Signal troops of SUTG are Third Army troops attached to the Signal Training Center for training and administration.

With only two weeks of active duty allotted for these neophytes of the communication field, who only days before had been redesignated Signal, a program was devised wherein the first week would be spent in the classroom covering basic fundamentals. The second week the Guardsmen were moved into field locations, thus exposing them to a tactical set-up which might be encountered in a real situation.

Upon completion of this two-week program, the Guardsmen departed well-pleased with their indoctrination to Signal. So much so that they requested they be allowed to return on weekends to further their training in the world of electrons. This request became a reality and SUTG went a step—a giant step—farther by offering Regular Army personnel to the Guard units to give instructions at their armory drills on week nights.

This program developed rapidly and was enthusiastically received. During this training, a "world first" was achieved in the use of closed circuit television from the television studios of the Signal Training Center to the armories. This feat received national recognition and SUTG's name became a by-word among Guardsmen for good training.

By mid-winter 1959-1960, thirty-one units had been scheduled for summer training at Fort Gordon for the coming year.

Again SUTG was called upon.

Given the mission of planning, presenting and advising the National Guard in all phases of Signal Technical Training, SUTG, commanded by Colonel John J. Fettig, conducted many conferences and discussions with the National Guard commanders and state advisors. From these meetings evolved a dual training program whereby the "old-timers," Alabama, Georgia and South Carolina, would move directly into a field communications problem with only a short orientation briefing. The newcomers, the States of Kentucky, Maryland, Mississippi and Virginia, who had no previous experience or training would be given formal school and on-the-job training.

It was decided that the field problem would consist of installing, operating and maintaining Theater and Army Area Signal Systems. Such systems existed in the Signal Integrated Training Facility, known as SITFAC.

SITFAC is one of the finest facilities existing today for training in modern communication concepts. It employs representative installations of area systems in a theoretic Theater of Operations, known as the Georgia Theater of Operations or GATO. This theater of operations is superimposed on Fort Gordon and surrounding states.

To reproduce Theater or Army Area Signal Systems in their entirety would not be feasible due to budgetary, space and equipment limitations. However, in order to present a true "across the board" picture, at least two representative sites of each type which might be encountered in these systems are found in SITFAC.

These sites currently consist of seventeen different representative installations dispersed over the 56,000 acre Fort Gordon reservation and off-Post "shots" into other states. Among them are two communication centers, one representing Theater Headquarters; the other representing Theater Army Headquarters. These are permanently installed Communications Centers composed of all types of equipment and means of communications inherent to such an installation. In addition to these ultramodern communications centers, there are three Army Area Signal Centers, telephone central offices, area control centers and area switching centers, with their several communications connotations. The establishment of interconnecting VHF, UHF and HF Radio, as well as wire systems, provides the media for the training of practically all Signal Military Occupational Specialties. Here were all the requirements necessary for presenting a realistic situation wherein the National Guard Signalmen could visualize and understand the role of the individual, as well as the team, in any communications problem.

To create realism, drill traffic is introduced into this system at the various Communications Centers, Signal Centers and simulated subordinate units; however, this input is not always sufficient to properly load the system. To overcome this, a Traffic Injection Center is employed. This center represents twenty-six Headquarters, not at all unlikely in an actual situation, and is capable of feeding 36,000 messages daily

into the system by means of precut tapes, using thirty-six teletype machines. This provides an excellent means for controlling the "workload" fed into the system. This "workload" can be varied, depending upon the number of trainees and their ability to handle traffic. From a slow trickle of messages, this may be increased to a veritable flood.

SUTG provided the technically qualified personnel to assist and supervise this program. These supervisors closely monitored the Guardsmen in the first week of field training; always on hand, always ready to give advice and assistance. During the second week, the Guardsmen were "on their own." The Regular Army advisors were there only to act if called upon by the Guardsmen, and this was done only in isolated instances.

Enthusiasm and diligent application on the part of the National Guardsmen "paid off." Prior to the conclusion of the problem, the Guard units were able to completely install, operate and communicate without the aid of the regular troop advisors.

Having only a limited number of personnel, SUTG was unable to conduct all of the formal classroom training required while supervising the field operation. A limited number of classes in Basic Electricity, Typing and Communication Center Operations were set up in SUTG and aid was solicited to provide most of the classroom training needed. This aid was provided by the Advanced Individual Training Group (AITG) and The Southeastern Signal School (TSESS), also subordinate commands of the Signal Training Center.

AITG conducted courses in message center procedure and operation, cryptography, telephone switchboard operation, telephone installation and repair, radio relay carrier operations, and a Basic Signal Officers Course which would aid the new Signal Officers in the training of their units at their local armories during the periods between active duty training.

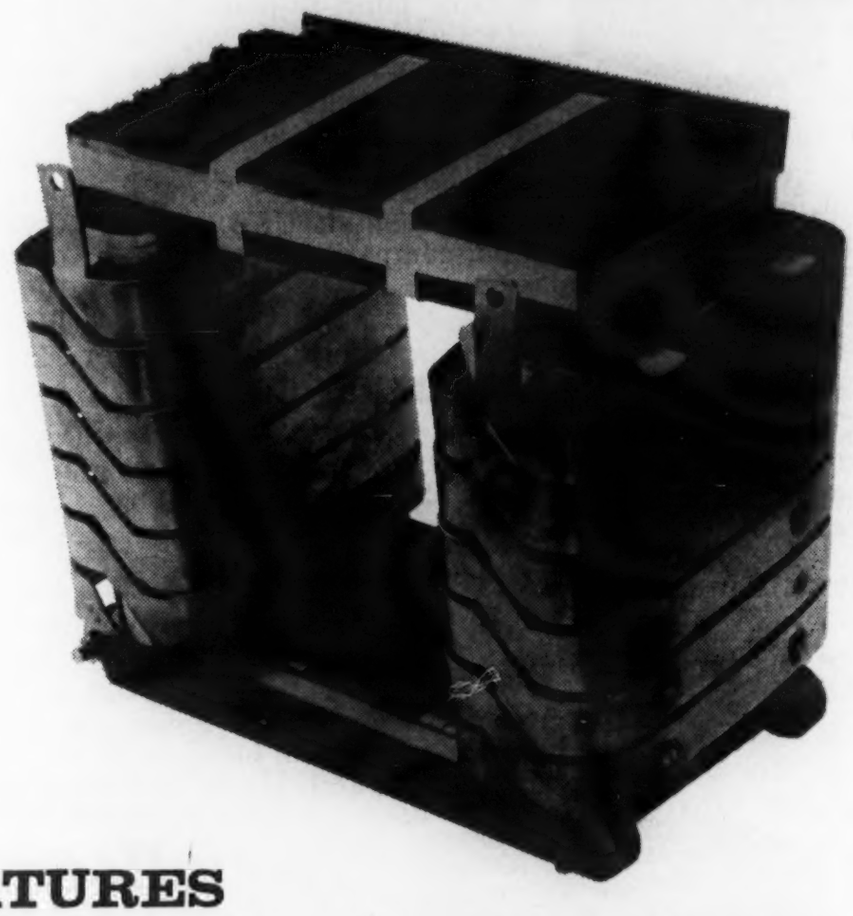
The Southeastern Signal School covered instruction in manual central office repair, powerman, instrument repair, field carrier equipment repair, field radio repair, central office supervisor, teletype repair, signal supply specialist, cable splicing and radio-teletype operations.

Not only the STRAC regulars of SUTG but military and civilian alike in AITG and TSESS all joined with the National Guard in a concerted effort to successfully accomplish one of the finest "One Army" operations to date.

Upon the completion of the 1960 National Guard Annual Active Duty for Training Program, it was the unanimous consensus that the Signal Unit Training Group and the National Guard had, in the finest cooperative effort to date, achieved the ONE ARMY CONCEPT.

ITA is proud to introduce its newest product...

BROAD BAND BALUN



FEATURES

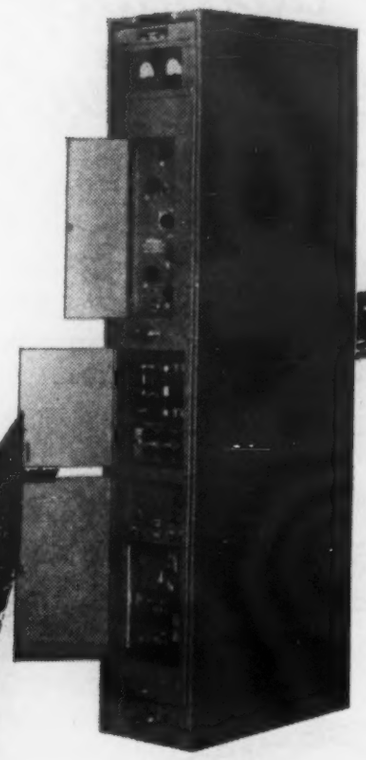
- COMPACT—OCCUPIES LESS THAN ½ CUBIC FOOT
- REQUIRES NO TUNING
- BROAD BAND FROM 4 TO 26 MC
- RATED AT 80KW PEAK POWER—20KW AVERAGE
- TRANSFORMS 37.5/75 OHM UNBALANCED TO 600 OHM BALANCED
- HIGH QUALITY TEFLON AND LOW LOSS FERRITE USED THROUGHOUT

ITA's Broad Band Balun is presently in operation in our 10KW and 20KW high frequency transmitters. It eliminates the necessity for retuning the unbalanced transmitter output to the balanced antenna load. ITA's Broad Band Balun is available on a standard and custom basis to meet your transmitter requirements. For detailed information write or phone us.

INDUSTRIAL TRANSMITTERS & ANTENNAS, Inc.
LANSDOWNE, PA. • CL 9-8200
ITA

NOW! MODERN SSB COMMUNICATIONS FOR APPROXIMATELY $1.00 PER WATT!*

...with *wilcox* factory new or interchange single sideband equipment



the wilcox 96SSB TRANSMITTER

provides the ultimate in reliable point-to-point and ground-to-air signal communications. Precise frequency control is maintained by temperature controlled crystals in the integral SSB exciter. The **96SSB** unit is highly versatile. The modes of service include USB, LSB, DSB, Independent Sideband, compatible AM, CW, TTY and data transmission.

TECHNICAL CHARACTERISTICS

Frequency Range: 2 to 30 mc. continuous.

Frequency Stability: 1 part 10^7; Aging, less than 1 part 10^8 per day.

Output Power: 5,000 watts P.E.P. (Class AB_1).

the wilcox 99SSB TRANSMITTER

RF channel with 1000 watts P.E.P. provides highly dependable service at any frequency from 2 to 32 mc. for matchless point-to-point and ground-to-air communications. Precise frequency control is maintained by temperature controlled crystals located in the SSB exciter. Like the 96SSB unit, the transmitter can be used in practically any type of transmission service.

TECHNICAL CHARACTERISTICS

Frequency Range: 2 to 32 mc. continuous.

Frequency Stability: 1 part 10^7; Aging, less than 1 part 10^8 per day.

Output Power: 1,000 watts P.E.P. (Class AB_1).

wilcox models 99 and 96 transmitters

which are in service with governmental agencies and private firms throughout the world, can be updated with Wilcox Interchange equipment to provide SSB capabilities at minimum trouble and expense.

the *wilcox* 605A SSB "STRIP" RECEIVER

is a highly sensitive and stable equipment consisting of separate IF/AUDIO unit used with one or more RF units. The IF/AUDIO unit is also an SSB converter when used in conjunction with a tunable HF Receiver. Use of a single IF/AUDIO unit and one or more RF units makes it possible to create a system capable of instantaneously selecting any predetermined exact frequency. By combining at IF frequency, space and/or frequency diversity is possible without the usual duplicate receiver cost. Also, USB and LSB IF channels can be used separately with two RF sections operating on different frequencies.

TECHNICAL CHARACTERISTICS

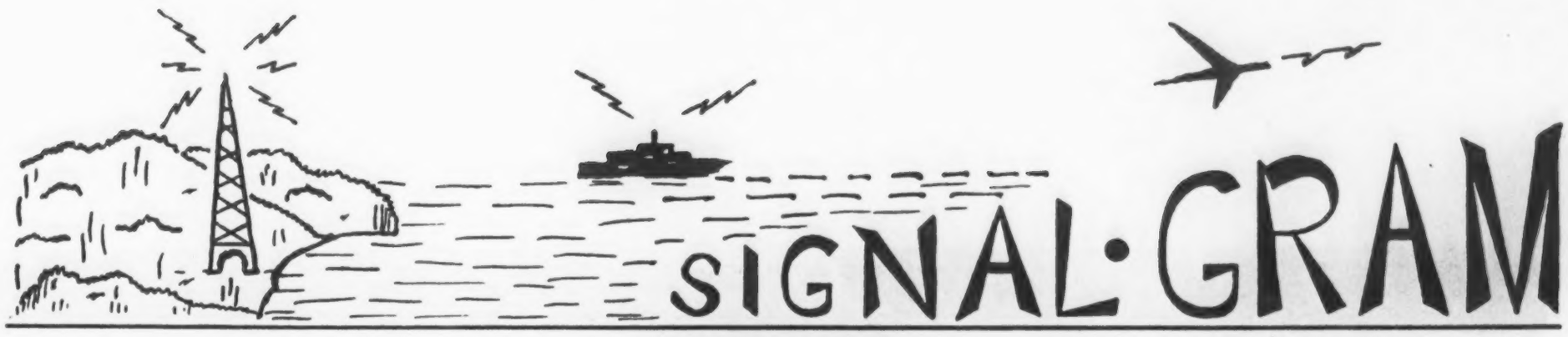
Frequency Range: 2-32 mcs.
Frequency Stability: 1 part 10^7 per day.
Sensitivity: SSB ½ uv for 100 milliwatt at better than 10 db SN/N.
Selectivity: SSB: ±3 db 300-3000 cycles. Unused SB Rejection —60 db minimum.
Output: 100 milliwatt min. into line. 1 watt min. into speaker.

***If 96 AM equipment is available for interchange, the cost of an SSB transmitter replacement is approximately $1.00 per watt.**

Write, wire or phone for more Technical Data on Factory New or Interchange Single Sideband Equipment . . .

wilcox Electric Company, Inc.

Fourteenth & Chestnut
Kansas City 27, Missouri, U.S.A.



SIGNAL·GRAM

—GOVERNMENT—

SOME NEW FACES around the Pentagon belong to Robert S. McNamara, Secretary of Defense; Roswell L. Gilpatric, Deputy Secretary of Defense; Eugene C. Zuckert, Air Force Secretary; John B. Connally, Jr., Navy Secretary; and Elvis J. Stahr, Jr., Army Secretary. Other new faces around Washington include Glenn T. Seaborg, Chairman of the Atomic Energy Commission and Newton H. Minow, Chairman of the Federal Communications Commission. Frederick W. Ford stepped down from this post, but remains an FCC member.

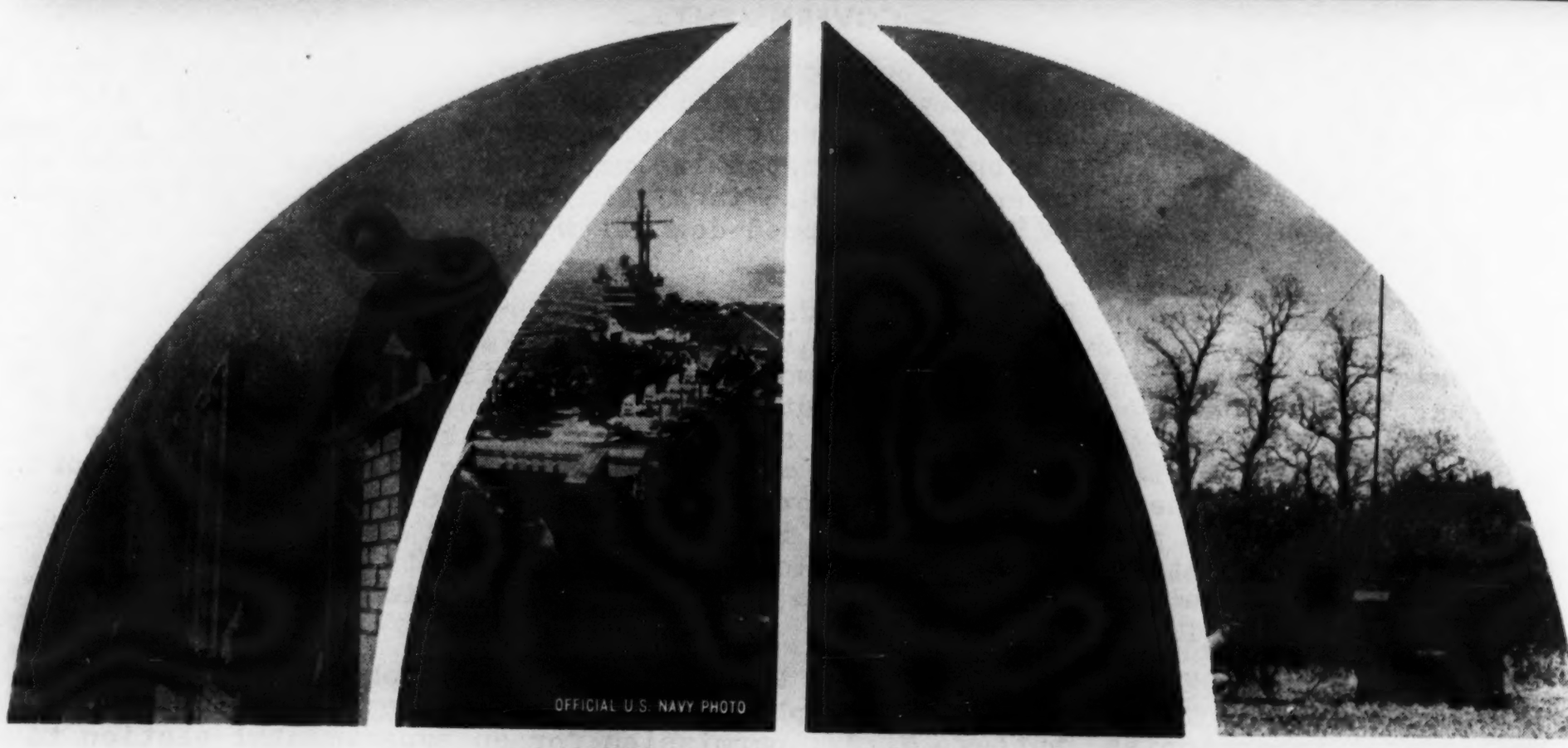
FCC YEAR-END STATEMENT by Frederick W. Ford, then FCC Chairman, notes that 1960 "marked one of the most eventful and significant of the Federal Communications Commission's 26 years. Many serious problems faced the Commission at the beginning of the year." Ford believes that the FCC "attacked these problems with unusual vigor which has resulted in many of them being solved and many others advanced to the point of decision." Important decisions were made regarding frequency allocations. The FCC ruled that there was enough microwave space above 890 mc to take care of both common carriers and private users. Because of the interest in space communication, the FCC initiated an inquiry into long-range requirements as far as non-Government users are concerned. Comments on space communications needs must be submitted by March 1.

FCC GRANTS SPACE COMMUNICATIONS LICENSES to International Telephone and Telegraph Corp. and American Telephone and Telegraph Co. On Jan. 12, the Commission granted ITT Federal Laboratories, Nutley, N. J., permission for an experimental station to bounce signals off the moon and passive earth satellites. The authorization specifies operation on 2120 mc or 2299.5 mc until July 1, after which only 2299.5 mc may be used. The Nutley station will use input power of 10 kw to a 40-foot steerable antenna for directing narrow-band transmission spaceward. On Jan. 19, the FCC authorized ATT to operate experimental radio stations for basic earth-satellite communication study. A fixed earth station at Holmdel, N. J., will transmit to and receive from radio installations on as many as six satellites yet to be launched. The Holmdel station will operate on 6325-6425 mc with 3 kw power into the antenna and the satellite stations will use 4100-4200 mc with 5 watts into the antenna. These grants, each for one year, are for experimental research only and do not mean that the frequencies authorized are those that are best suited for space communications or that these frequencies will be made available for such communications on a regular basis, the FCC states.

AF AIRBORNE COMMUNICATIONS CENTER nicknamed Talking Bird is completing a five month round-the-world test and evaluation program. The flying command post/communications center, which left the United States on Jan. 5, will visit Latin America, Africa, the Near East and the Far East. Mounted in a specially configured C-97E test aircraft, the communication facilities include single sideband radios, a telephone switchboard, portable radios for remote airfields, and a complete command post with working and living space for eight. At various stops and while airborne around the world, the Talking Bird aircraft will test direct voice and teletype contact with the Air Force Command Post in the Pentagon and with other Air Force headquarters throughout the world.

VICE ADMIRAL H. G. RICKOVER received the Distinguished Service Medal aboard the USS Nautilus, Jan. 17, in a ceremony commemorating the sixth anniversary of nuclear naval power. Just prior to the ceremony at Groton, Conn., officials took part in laying the keel of the fleet ballistic missile submarine USS Lafayette, using power supplied by Nautilus.

NASA-BRITISH SCIENTISTS discussed plans for the first British satellite at a series of meetings recently completed, and agreed on the practicability of using a Scout rocket for the proposed satellite experiments. In addition, a number of joint discussions about the scientific instrument payload for a second British Scout satellite have been held in recent months. These joint meetings are an outgrowth of an NASA offer to provide launching facilities for experiments of mutual interest prepared by scientists of other countries. (*Continued on page* 35)



the scope of

f alpha

FROM A CONCEPT TO DEMONSTRATED WORLD-WIDE CAPABILITIES IN LESS THAN TWO YEARS

Alpha Corporation in its systems engineering and management role is playing a vital part in highly diversified communications, instrumentation and control systems for government and industry.

Pacific Missile Range instrumentation, communication and data handling systems serve the nation's largest missile range, stretching from Point Mugu westward, by way of islands and range ships.

Satellite and deep space probe air transportable tracking and communications systems for NASA, JPL and the Signal Corps have been engineered to handle a wide range of missions.

Naval Tactical Data System makes possible rapid transmittal and display of radar, fire control and similar types of data simultaneously between all elements of a naval task force deployed at sea.

Short Order system provides positive two-way voice contact needed to control all airborne elements of Strategic Air Command through any of four widely dispersed HF single sideband station complexes.

Air Transportable Communication Central allows Marine Corps command post to route teletypewriter, voice and telegraph communications between landlines and self-contained HF single sideband station with complete switching flexibility.

Project Echo passive satellite communication experiment successfully transmitted voice, teletypewriter and facsimile between Collins at Cedar Rapids and Alpha at Dallas in joint company-financed tests of feasibility of satellite relay communication.

Far East Tropospheric Scatter System provides multiple channels for voice, teletypewriter and data communication between Formosa and Okinawa, a 410-mile over-water link in the Armed Forces Pacific Scatter Network.

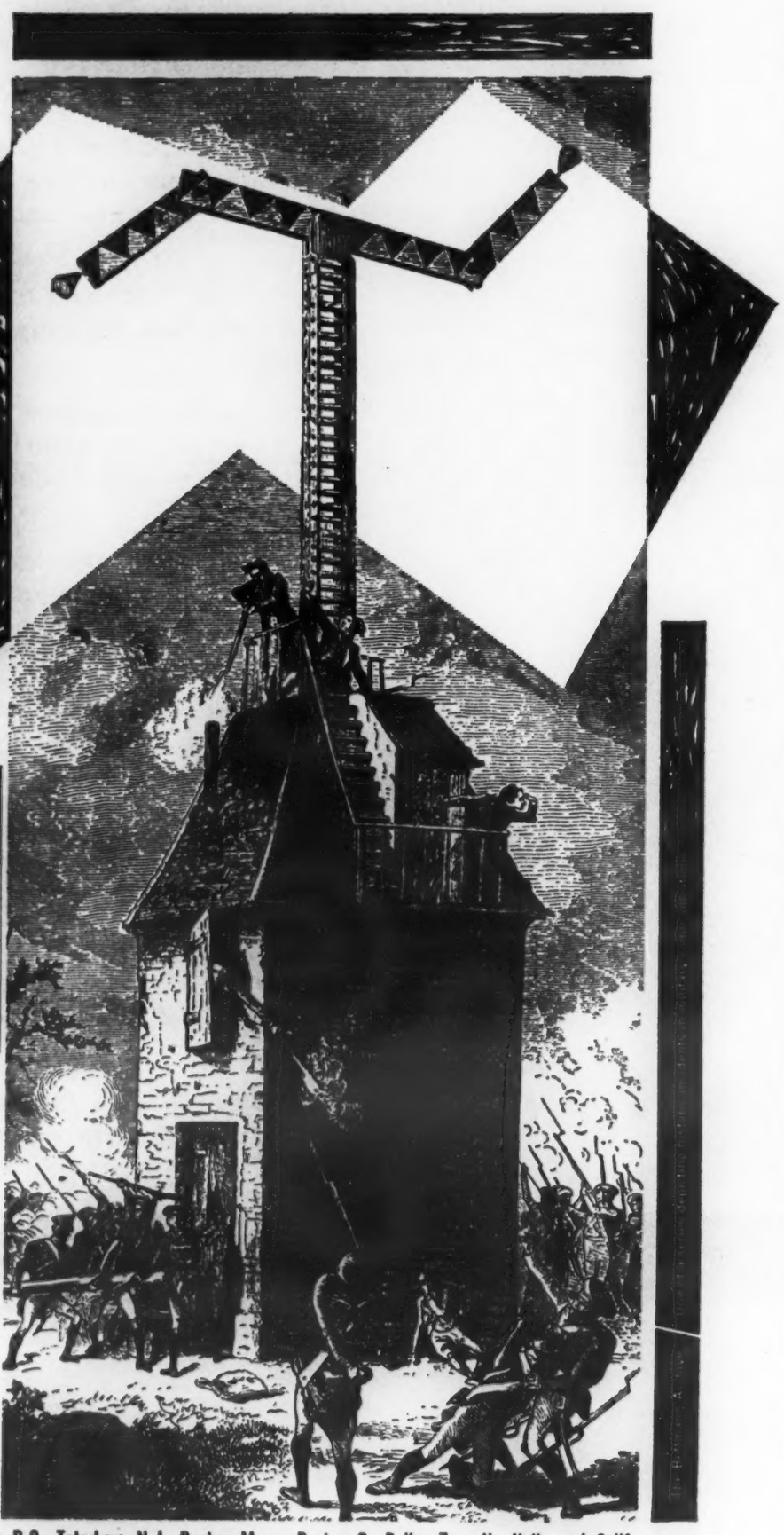
Asiatic Petroleum 500-mile communication system combines Tropospheric Scatter and Microwave to link Shell Oil's Venezuelan Headquarters at Caracas with its refinery at Cardon, and its western oil operations area.

Alpha CORPORATION
A SUBSIDIARY OF COLLINS RADIO COMPANY
SYSTEMS DESIGNERS, ENGINEERS, CONSTRUCTORS, WORLD-WIDE
RICHARDSON, TEXAS • TELEPHONE DALLAS ADams 5-2331

LONG RANGE INPUT / 1794

News of the recapture of Condé from the Austrians was sped to the French Revolutionary Convention at Paris in a matter of minutes via Claude Chappe's amazing télégraphe aérienne, or relay aerial telegraph, Sept. 1, 1794. A new era in rapid communications had begun.

Today, instantaneous and completely reliable Electronic Communications insure the immediate and continuous interchange of intelligence throughout the Free World. ECI is proud of its initiative and responsibilities in the design, development and manufacture of high precision electronic equipment to the critical specifications required in various aerospace and surface roles vital to our National Defense and to scientific achievement. An example is ALRI—Airborne Long Range Input—a program where ECI communications and data link equipment fill an integral and essential requirement in linking USAF's advanced early warning system to SAGE—our continental defense network.



System
Development
Communications
Data Link
Countermeasures
Computers
Actuators

ELECTRONIC COMMUNICATIONS, INC.
St. Petersburg, Florida

RESEARCH DIVISION
Timonium (Baltimore), Maryland

ADVANCED TECHNOLOGY CORPORATION (ADTEC)
Santa Barbara, California

REGIONAL OFFICES: Washington, D.C., Teterboro, N.J., Boston, Mass., Dayton, O., Dallas, Tex., No. Hollywood, Calif.

AFCEA's Role in CIC

(Continued from page 24)

bile interference unit maintained by the Alabama CIC was employed to locate the source of this interference, which was found to be a local paper company that had just installed five 5-kilowatt industrial heaters. Mr. Bomar secured the cooperation of the paper company in adequately shielding the space occupied by the offending equipment.

Colorado CIC

On September 1, 1960, at least 10 station licensees operating stations in the 460-470 mc region reported to William L. Detwiler, a member of the Complaint Section of the Colorado CIC, that severe interference was being experienced by these stations from each others' operating frequencies, much like a cross-modulation effect. All the complaining base stations are located on Lookout Mountain, near Denver, and are remotely controlled. Radio users suffering the interference included an auto service company, a concrete company, an oil company and a laundry.

Mr. Detwiler proceeded to Lookout Mountain and traced the source of interference to an apparently defective super-regenerative receiver which had been put into temporary, experimental operation by a Class "B" Citizens Band licensee. This receiver was "unknowingly" retransmitting, on a variety of frequencies, the signals which it picked up from nearby transmitters. The owner of the offending receiver immediately discontinued its use upon being made aware of the problem.

New Mexico CIC

In August 1960, Elbert E. Ginn, Jr., Chairman of the New Mexico CIC, received a request from military authorities at Sandia Base, Albuquerque, New Mexico for assistance in resolving a problem of interference on a Department of the Army assigned frequency which was believed due to second harmonic emission from a local standard broadcast station.

Measurements by the New Mexico CIC and the broadcast station showed that the station's second harmonic was attenuated 63 db below the fundamental. Further investigation by the New Mexico CIC disclosed that the problem was attributed to antenna coupling circuit changes which had recently been made at a new military antenna site at Sandia. Improvement of the receiving antenna coupling circuitry eliminated the interference.

AF BLUE SCOUT I ROCKET was used to measure different types of environmental conditions in space after its launching Jan. 7 from the Atlantic Missile Range. Attempts to recover the Scout's payload ejected in the Atlantic failed. Scout I is a guided three-stage solid propellant rocket using the first, second and third stages of the NASA Scout research rocket modified to integrate either hypersonic lifting bodies with the third stage engine or standard payload carriers and data recovery systems. The Scout research rocket program, which includes four other vehicles besides Blue Scout I, is directed by the Air Force Ballistic Missile Division of the Air Research and Development Command.

MEASUREMENT TECHNIQUE for calibrating attenuators over a wide frequency range has been developed by the National Bureau of Standards' Laboratory at Boulder, Colo. NBS believes this technique will result in extending the accurate service previously available at 30 mc to include similar calibration service at 1, 10, 60, 100 and 300 mc. Attenuators are devices that are used in almost all instrumentation in which radio frequency is used to either measure or control power loss in a system.

CONTRACTS: ARMY: Avco Corp., Electronics and Ordnance Div., production of components for AN/VRC-12 tactical radio set, $34.9 million; Ford Motor Co., Aeronutronic Div., continued research and development of Shillelagh weapons subsystem, $3 million. NAVY: Grumman Aircraft Engineering Corp., additional production of A2F-1 Intruder aircraft, $70.1 million; Hughes Aircraft Co., continued production of inertial guidance systems for Polaris missile, $6.6 million; Raytheon Co., continued work in providing industrial support to Massachusetts Institute of Technology in design and development of Mark II inertial guidance system for Polaris missile, $2.5 million. AIR FORCE: General Electric Co., Defense Systems Dept., continued work on the radio-command guidance system for the Atlas missile; RCA Service Co., installation and checkout of ground equipment for Titan missile, amount not specified (subcontract from The Martin Co.)

—INDUSTRY—

SPACE TECHNOLOGY LABORATORIES, INC. has been selected by NASA for contract negotiations for the orbiting geophysical observatory. The initial contract calls for delivery of three flight space craft to the space agency within three years. The $15 million contract will be negotiated and managed by the Goddard Space Flight Center.

INDUSTRIAL TEAM has been chosen by the National Aeronautics and Space Administration for contract negotiations to conduct a study of the requirements for a National Nuclear Rocket Engine Development Facility. The proposal for the four-month architectural and engineering study was submitted by the Ralph M. Parsons Co., in association with the Thiokol Chemical Corp., representing TALANT. TALANT is a team consisting of Thiokol, the Allison Division of General Motors, Linde Co., a division of Union Carbide Corp., and Nuclear Development Corporation of America. The study will include data on site considerations, the number and type of test stands needed, control center, support facilities, construction costs and schedules.

TWO DYNA SOAR CONTRACTS were awarded recently. Radio Corporation of America, Defense Electronics Products will develop a complete communication subsystem for the Dyna Soar test program under a multimillion dollar contract from the Air Force Aeronautical Systems Center. Work will include the development of a tracking network utilizing data link communication techniques. Minneapolis-Honeywell Regulator Co. was awarded a letter contract for the first phase development of the inertial guidance system for the Dyna Soar vehicle. Dyna Soar is a manned space craft which will be capable of orbiting the globe and then re-entering the atmosphere for an airplane-like landing. Boeing Airplane Co. is the system contractor and is responsible for building the glider, integrating subsystems and supporting the Air Force test program.

ELECTRONIC HIGH SPEED AUTOMATIC MONITOR SYSTEM for control of nuclear reactors has been built by Monitor Systems, Inc., a subsidiary of Epsco, Inc., Fort Washington, Pa. The solid state electronic system demonstrates the practicality of monitoring nuclear reactor temperatures on a high speed ultra reliable basis, according to MSI. The system can measure 116 reactor temperatures at a speed of 5,000 per second.

GE'S INDUSTRIAL CENTER PLANT will be used for the design, development, production and testing of radar and underwater detection equipment being manufactured by General Electric's Heavy Military Electronics Dept. The recently dedicated $8 million plant in Syracuse (N.Y.) will permit the consolidation of widely dispersed and interdependent groups of engineering and manufacturing personnel in HMED.

ITT FEDERAL LABORATORIES will develop and build twenty receivers for the Navy's Omega long range worldwide navigation system. Taking its name from the last letter of the Greek alphabet, the Omega (for ultimate system) is aimed at providing ships and aircraft with a "fix" accuracy of one mile and could furnish global coverage with a net consisting of only eight transmitting stations. ITT Federal Labs, a division of International Telephone and Telegraph Corp., was formed in December by the consolidation of ITT Laboratories and ITT Federal Division.

COMPUTER-OPERATED TEACHING SYSTEM with the ability to tailor its instructions to an individual student's talent has been created by System Development Corp., Santa Monica, Calif. Heart of the system is an electronic computer, programmed to sense a student's needs, respond to his errors, and build his knowledge and confidence quickly and reliably, according to SDC.

NBS-INDUSTRY MEASUREMENT RESEARCH CONFERENCES have been held at the National Bureau of Standards during the past several months. At these meetings, industry measurement specialists from member firms of the Aerospace Industries Association and NBS technical staff members discussed measurement problems affecting the aeronautical and missile industries. The meetings are a follow-up to the AIA Industry Calibration Survey, which identified many specific areas in which industry faced measurement problems.

WESTERN UNION TELEGRAPH CO. has established field offices at six key locations in the United States to handle communications needs and liaison activities on major government and military communications projects. Offices are located at Boston, Mass.; Jacksonville, Fla.; Belleville, Ill.; Omaha, Nebr.; Colorado Springs, Colo. and Los Angeles, Calif.

SOURIS RIVER TELEPHONE MUTUAL AID CORP. has provided communications services for a Direction Center in the Minot (N.D.) Air Defense Sector network. The independent telephone company presented a major portion of the network to the Air Force last November. The equipment, estimated at $5 million, provides the internal communications system, the initial circuits for all completed and programmed communications equipment and several external communications outlets.

ELECTRONIC EQUIPMENT RELIABILITY HANDBOOK used by the U. S. Air Force's ground electronic equipment research and development center at Rome, N. Y., is being made available to industry through the Office of Technical Services, Business and Defense Services Administration, U. S. Department of Commerce, Washington, D. C. (Order PB 161 894 from OTS, $4). The RADC NOTEBOOK contains specifications prepared by Rome Air Development Center covering both development and production models of electronic equipment. These specifications require that a contractor design equipment to meet a specific reliability figure and demonstrate by tests that the figure has been met.

—GENERAL—

R&D BUDGETS by 1970 will reach an annual volume of $24 billion, doubling the amount spent in 1960, predicted Martin Goland, President of Southwest Research Institute. He called for a national research effort to channel these funds effectively.

EMPLOYMENT OPPORTUNITIES for business executives will not slacken in 1961, if the predictions contained in a survey of 178 companies are correct. The survey was conducted by Executive Manpower Corp., New York and Washington, D.C., a management recruitment firm. The report shows a need for slightly better than one executive per firm for jobs paying from $10,000 to $75,000 annually.

ELECTRONICS INDUSTRY FORECAST for 1961 has been made by L. Berkley Davis, President of the Electronic Industries Association. He believes that total electronics sales will be "strongly supported by increases in defense requirements and steady expansion of the industrial electronics market." Cautioning the manufacturers, Davis warns that they will face much competition, and believes that only those electronics manufacturers who keep abreast of the rapid technical developments in electronics will survive.

ELECTRICAL MANUFACTURING INDUSTRY showed an increase in factory shipments in 1960 which was 5% above the 1959 mark, according to National Electrical Manufacturers Association. Viewing 1961 with caution, NEMA believes that the government's attitude on the number and value of defense contracts for electronics and communications equipment will play a major part in the industry's future. A decided boost in such contracts could send the value of the industry's factory shipments beyond present levels.

ECONOMIC AND MANAGEMENT PROBLEMS will be discussed by ten chief executives of major corporations at the 1961 Conference for Business and Industry, sponsored by the American Management Association, Feb. 20-22, in Seattle, Wash. (*Continued on page 38*)

PANELS

(1) Federal Bar Association Panel on Government Contract Law and Procedure (Participants include the Assistant General Counsels of the Army, Navy and Air Force.)

(2) Scientific Applications of Photography as Related to Communications and Electronics.

(3) Present Status and Future Concepts of World-Wide Communications to be presented by ITT Federal Laboratories.

(4) Industry Report on Communications and Electronics Developments to be presented by General Telephone & Electronics Corporation.

SPEAKERS Prominent speakers have been engaged for the Banquet, Keynote Luncheon and Industrial Luncheon. Their names will be announced in subsequent issues of SIGNAL.

EXHIBITS Two adjoining hotels will contain quality exhibits from companies which are leaders in the communications-electronic fields plus special exhibits by the Army, Navy and Air Force.

SOCIAL EVENTS Keynote Luncheon—Sparkling entertainment at the Buffet featuring fabulous acts—The magnificent Banquet of Banquets—Industrial Luncheon. Be sure to invite your guests and reserve your tables early.

JUNE SIX SEVEN EIGHT

15th AFCEA Convention • Washington, D. C.
Sheraton-Park and Shoreham Hotels

JAPANESE ELECTRONICS output may increase 82 percent in 1964 over actual production in 1959, according to the Electronics Division, Business and Defense Services Administration, Commerce Dept., which received this data from the Japanese Ministry of Trade and Industry. This 1964 output figure would be at the rate of about $1.8 billion. An earlier estimate called for an increase of 32 percent.

SCIENCE INDUSTRY CENTER patterned after Stanford Research Center, in Menlo Park, Calif. is being developed near Minneapolis, Minn. by International Properties, Inc. Two companies, Miniature Instruments and National Connector Corp. occupied the first buildings constructed at the suburban center last month. Two other companies, Electro Nuclear Systems Corp. and Nedmac, Inc. plan to build in the near future. International Properties eventually plans to locate about two dozen plants of contemporary design on its 190-acre center.

HEBREW ALPHABET is now being used in transoceanic radio news communications by the Jewish Telegraphic Agency which recently opened a radio facsimile circuit between its New York headquarters and the Tel Aviv office of the Israeli News Agency. Israeli correspondents stationed in the United States now will be able to write their articles in Hebrew for transmission in the Hebrew alphabet. Previously, these dispatches were written in a transliterated Hebrew, using English characters to represent the Hebrew sounds.

CREATION OF A WAR SAFETY CONTROL GROUP would help solve many of the world's fears of future wars, according to Howard Kurtz, management consultant, Handy Associates, Inc., who has prepared a report entitled "Control of World Crisis." This report states that such an organization would be capable of providing simultaneous national security for all nations.

HIGH ALTITUDE INTERFERENCE can be measured by a prototype satellite instrument package being designed and constructed for the Air Force's Wright Air Development Division by Armour Research Foundation. The flight model to be developed from the ARF prototype, when launched, is expected to yield information pertinent to the design of future aerospace communications systems. Specifically, the package will monitor the electromagnetic environment of the satellite over selected ranges of the frequency spectrum as it passes through space.

UNORTHODOX COMMUNICATIONS SYSTEMS might be used in a future nuclear war, according to Dr. Leonard S. Sheingold, Director, Applied Research Laboratory, Sylvania Electronic Systems. These systems would include the use of orbital scatterers placed in polar and equatorial circular belts at altitudes between 2,500 to 5,000 miles; artificial ionospheres which reflect radio waves to a reception point beyond the horizon; transmission of low data rate messages through earth currents; a rocket with a "canned" message which could be repeated over very large areas for a brief period of time; communication equipments and antennas which can be reconstructed after a nuclear strike through use of a supply of modules buried in underground sites.

MACHINE INDEXING will be the theme of the Third Institute on Information Storage and Retrieval, Feb. 13-16, at The American University in Washington, D. C. Leaders in the theory and research of automation for indexing scientific documents and other information will lead sessions on problems and progress in the field.

SUPER-POWERED TRANSMITTER-RECEIVER for space exploration by radar will be built near Lima, Peru, by the National Bureau of Standards. The Peruvian installation, which is at the magnetic equator, is expected to enable observations up to 1800 miles, more than four times the range achieved in earlier experiments. Classed as a major scientific feat, radar space exploration studies the ionosphere and the exosphere with equipment located entirely on the ground. The method employs both a transmitter with a peak pulse power of 6 million watts which sends out from the earth a very high frequency wave, and an extremely sensitive broadside antenna that detects the faint re-radiation of the pulsed radio wave by free electrons in the upper atmosphere.

CALENDAR OF EVENTS

FEBRUARY 14-16: Second Annual Symposium on Nondestructive Testing of Aircraft and Missile Components, sponsored by South Texas Section of the Society for Nondestructive Testing, Inc. and Southwest Research Institute, Gunter Hotel, San Antonio, Tex.
FEBRUARY 15-17: International Solid State Circuits Conference, sponsored by Institute of Radio Engineers and American Institute of Electrical Engineers, Sheraton Hotel, Philadelphia, Pa.
FEBRUARY 17-21: International Exhibition of Electronic Components, sponsored by the Federation Nationale des Industries Electroniques, Paris, France.
FEBRUARY 19-26: Brotherhood Week, sponsored by National Conference of Christians and Jews.
FEBRUARY 26-28: Pacific Electronic Trade Show, Great Western Exhibit Center, Los Angeles, Calif.

The International Academy of Astronautics of the International Astronautical Federation

by ANDREW G. HALEY
General Counsel
International Astronautical Federation

THE INTERNATIONAL ASTRONAUTICAL Federation has completed the organization of the International Academy of Astronautics. The Academy is composed of leading scientists and sociologists of the world who are engaged in these fundamental aspects of astronautics: (1) basic science, (2) engineering, and (3) the life sciences, including medicine, law, and other fields dealing with life and survival in space.

The principal powers and functions of the Academy are to: (1) provide advice to the President of the International Astronautical Federation when requested; (2) hold scientific meetings and make scientific studies and reports; (3) publish *Acta Astronautica,* an international technical publication devoted to astronautics; (4) award medals and prizes intended to further the progress of the field; (5) carry out such other tasks as may be deemed desirable for promoting the advancement of astronautics.

The Academy was formally organized in Stockholm during the Eleventh Annual Congress of the International Astronautical Federation, August 15-20, 1960. The first meeting of the Academy took place during the Congress on August 16, 1960.

Dr. Theodore von Karman, Chairman of the Founding Committee, was designated as Director of the Academy. Professor J. Pérés and Dr. Frank J. Malina were designated as Deputy Directors.

The Academy is organized in three Sections: I, Basic Sciences; II, Engineering Sciences; and III, Life Sciences. The Chairmen are: Professor A. Ehmert, R. Pesek, and Mr. Florkin, respectively.

The initial membership of the Academy includes some 55 persons. It is expected that approximately 150 persons will constitute the full membership.

The members of Section I, in addition to Professor Ehmert, are: Prof. H. O. G. Alfven, Prof. P. Auger, Prof. Nicolas Boneff, Dr. J. G. Davies, Prof. Vladimir Guth, Prof. Walter S. Hill, Dr. Joseph Kaplan, Prof. E. C. B. Lovell, Prof. M. Nicolet, Prof. J. Pérés, Dr. Irene Sanger-Bredt, Dr. Lyman Spitzer, Jr., Prof. H. C. Urey, and Dr. J. A. Van Allen.

The members of Section II, under the chairmanship of Professor Pesek, are: Prof. J. Ackeret, Dr. W. von Braun, Prof. L. Broglio, Prof. E. A. Brun, Mr. A. V. Cleaver, Prof. G. A. Crocco, Dr. H. L. Dryden, Prof. A. Eula, Dr. T. von Karman, Prof. J. M. J. Kooy, Prof. L. Malavard, Dr. F. J. Malina, Dr. H. Oberth, Dr. W. H. Pickering, Dr. E. Sanger, Dr. L. R. Shepherd, and Ing. Teofilo M. Tabanera.

The members of Section III, of which Professor Florkin is chairman, are: Prof. R. K. Andjus, Gen. P. M. Bergeret, Prof. I. C. Cooper, Dr. E. Evrard, Brig. Gen. D. Flickinger, Prof. W. R. Franks, Mr. A. G. Haley, Prof. J. Lederberg, Dr. W. Randolph Lovelace II, Prof. Alex Meyer, and Dr. H. Strughold.

The Academy has received generous donations of funds, headquarters space and other assistance. The Daniel and Florence Guggenheim Foundation of New York has approved a grant of a total of $75,000 for the work of the Academy. Headquarters office space in Paris has been furnished free of charge for three years through the efforts of General Paul Bergeron. The offices are located at the Caisse Nationale des Marchés de l'Etat, 12 rue de Gramont, Paris 2e.

Program for the Future

The program of the Academy for the future was described by Dr. von Karman at the first meeting, as follows:

"(a) *Advice to the President of the I. A. F. upon request.* One of the principal functions of the Academy is to provide advice to the President of the Federation whenever so requested. The Academy stands ready to give such advice to the best of its ability.

(b) *Astronautica Acta Journal.* The editorial management of the Acta was reorganized under my direction during the first part of 1960. A number of the initial members of the Academy are serving either in an editorial capacity or on the Editorial Advisory Board of the Journal. The Journal is intended to serve the rapidly growing community of scientists and engineers who are devoting themselves to any of the many aspects of astronautics as a publication having a widely international character. Furthermore, it is planned to cooperate closely with the publishers of several national journals. It is the intention of the editors of the *Acta* to supplement rather than compete with other journals in this field. Special attention will be given to articles of the type that will serve as valued cornerstones of the edifice of astronautical literature. It is also planned to publish periodically survey papers in the selected fields of the fundamental, engineering, and life sciences bearing on astronautics. Consideration is being given to the desirability of adding a section for short reports submitted by members of the Academy, and for letters dealing with matters published in the Journal. A short section giving Academy news might also be usefully added.

(c) *Scientific Meetings.* No change is contemplated as far as the Congress of the Federation is concerned. It is proposed, however, that smaller scientific meetings of the symposium type held in conjunction with the Congress be the responsibility of the Academy, at least as far as the tech-

(*Continued on page* 42)

MILITARY OSCILLOSCOPES PASS RIGID TESTS FOR RADIO INTERFERENCE

by JOHN TATUM
Engineering Group Leader, Oscilloscope Division
Hewlett-Packard Company

Figure 1: *Testing equipment for RFI. Model 170A 30 MC Oscilloscope and plug-ins on test bench; Empire Devices and Stoddart noise receivers on test console at right; dipole antenna on tripod in middle foreground.*

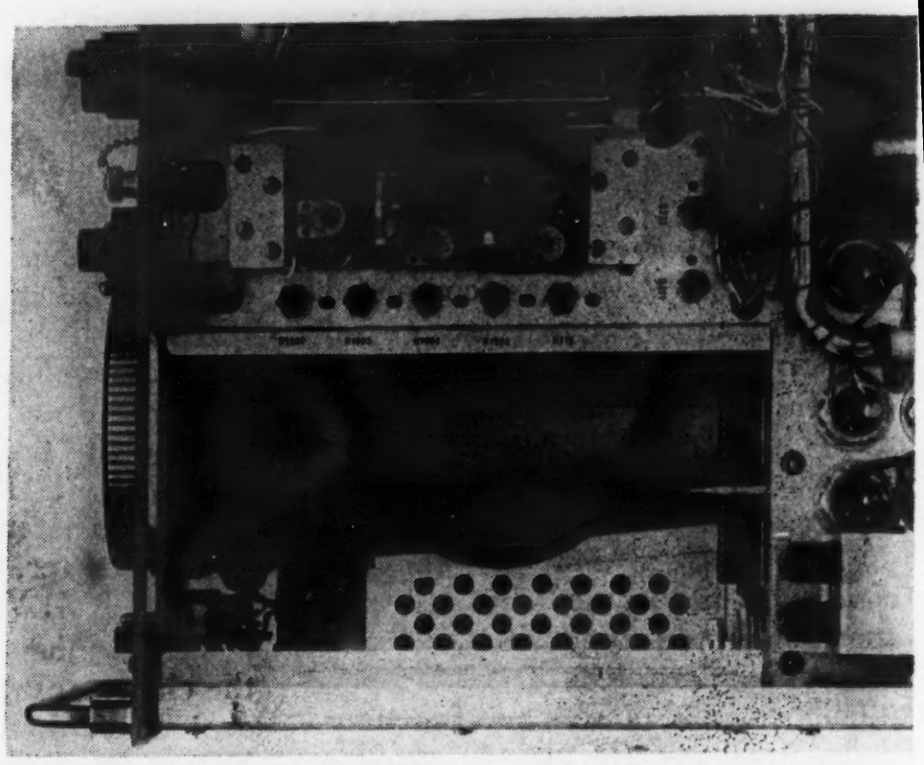


Figure 2: *A bottom view of the oscilloscope shows the chopper-blanking delay cable, high voltage power supply cage and CRT Mr-metal shield. The sweep plug-in was removed to show these components.*

AS LARGE USERS of electronic equipment, military and other government facilities have been instrumental in establishment of standards for specifying maximum allowable radio frequency interference. More sensitive receivers, higher usable communications frequencies, and the introduction of more and more electronic equipment have all contributed to the increased attention being given to reduction of RFI.

Minimum radio frequency interference cannot be attained merely as an afterthought by such obvious means as shielding. As electronic devices operate at faster speeds, the steeper wavefronts of the internally generated signals create high frequency interference that is harder to suppress. Moreover, a short length of wire becomes an effective antenna at high frequencies. It becomes increasingly difficult to find an effective ground at high frequencies because of ground currents which increase the difficulty of filtering and isolation. For these reasons, reduction of RFI must be a major objective of the entire design program for a new instrument.

RFI as discussed in this article concerns test instruments in general, and in particular the new Model 170A 30 MC Militarized Oscilloscope developed by the Hewlett-Packard Company. Reduction of RFI to meet requirements of MIL-I-16910A was one of the prime objectives in developing this instrument.

Model 170A

The Model 170A Oscilloscope is a general purpose test instrument with both sweep and vertical plug-in units to achieve maximum versatility. The main vertical amplifier has a pass band greater than 30 mc. The instrument is enclosed in a portable cabinet with detachable front cover which contains required cables, adapters, and other accessories.

Vertical and sweep plug-ins were tested with a main oscilloscope unit. Plug-ins include a Model 162A Dual Trace Amplifier that can display two signals simultaneously, alternately, or either one separately; a Model 166C Display Scanner that will permit a permanent record of a cathode ray tube (CRT) display on a graphic recorder; and a Model 166D Sweep Delay Generator that permits fast and slow sweeps to be displayed simultaneously.

In any oscilloscope there are many sources of RFI. As the frequency of operation of the various oscilloscope circuits is increased, the possibility of these noise sources causing interference to external devices is also increased. RFI can be filtered out, suppressed, contained by shielding, or minimized by circuit layout or lead dress.

Filtering or shielding represent "brute force" methods. This simply means that nothing is done to minimize the interference except that an electrical circuit or shield keeps the interference from affecting external circuits. A shield also prevents outside interference from entering the shielded circuits.

Suppression may be accomplished by such devices as resistors, ferrite beads, chokes and capacitors. These devices damp oscillations or keep them from being generated.

Testing for RFI requires the detection and accurate measurement of spurious signals which emanate from the instrument. To minimize outside interference, tests are normally conducted under controlled conditions in a screen room. Specialized, accurately calibrated noise receivers and a dipole antenna are shown in figure 1.

In the tests conducted on the 170A, noise receivers in a shielded test room searched the spectrum from 14 kc through 1000 mc for radio noise from the oscilloscope. Environmental testing located several noise sources in early prototypes of the oscilloscope. Some of the remedies employed to reduce noise in the oscilloscope are discussed in the following paragraphs. Similar techniques and circuits also can be used to attenuate conducted and radiated noise in other devices.

Conducted Noise

Conducted interference is interference that appears on the power conductors of electronic equipment. Some unusual conducted noise below 150 kc originated in solid state diodes and transistors in the power supply of the 170A. Rectifying and regulating action of the diodes and transistors caused broadband noise generation that the noise receiver detected. Adequate capacitive filtering was installed in the power supply to reduce this interference to an acceptable level. Small (.02 to .1 mf) capacitors were placed across each separate ac secondary transformer winding to attenuate switching noise from the semiconductors used in the power supply.

Another source of conducted noise was discovered at fast sweep speeds when signals from the sweep generator and amplifier were conducted back into the power supply and finally into the power line. Installation of a low-pass filter with a 150 kc cutoff reduced this noise by more than 50 db to meet the specifications in MIL-I-16910A.

Lead dress (the way a wire is routed) sometimes encourages or reduces an oscillation, excess coupling or radiation. For instance, the Model 162A Dual Channel Amplifier has a "chopper" which alternately switches the signal from each of the two preamplifier channels at a 1 mc rate. The chopper blanking delay line between the vertical preamplifier and the blanking circuit in the HV power supply in an early Model 170A was routed along the power supply chassis near a filter choke. High frequency chopper blanking pulses were coupled to the power supply and then conducted into the power line. Rerouting the delay line so that it was shielded from the choke reduced the interference to an acceptable level. The chopper delay line, CRT shield and high voltage power supply cage are pictured in figure 2.

Radiated Noise

Radiated interference is the electromagnetic field emanating from and existing around an instrument. Radiated noise can be just as troublesome and elusive as conducted noise. For example, the input amplifier in the 166D Synchronizing Delay Generator developed a strong oscillation at 100 mc. Placing a 220 ohm resistor in series with the grid of an input trigger amplifier eliminated the oscillation. The resistor lowered the "Q" of the lead to the grid enough to prevent oscillation.

Ferrite beads are also useful for suppression of high frequency oscillations. In the 170A a cathode follower in the main vertical amplifier developed a persistent high frequency oscillation. A ferrite bead (a small cylinder of ferrite material with a hole through the middle) on the grid lead to the cathode follower increased the loss at frequencies above the normal passband of the oscilloscope so that the oscillation stopped.

Another source of trouble was the rf power supply that generates the high voltage for the cathode ray tube. RF at a frequency of 50 kc was radiated through the cabinet openings. Installation of inside screening over the cabinet louvers and grounding the aluminum air filter to the air filter holder reduced this radiation as well as that from other sources to an acceptable level.

Mechanical shielding around the high voltage power supply oscillator, and a mu-metal mechanical shield around the cathode ray tube keep stray magnetic and electrostatic fields from affecting the CRT beam. The metal cabinet and panel form an integrated unit that keeps outside radiation from entering the oscilloscope and at the same time keeps internal radiations inside the oscilloscope. Large dimples were formed in the back of the cabinet to provide a low resistance chassis ground in order to reduce radiation from the back of the chassis to a minimum. Previous attempts at grounding with long bolts and relatively small area contact between the back of the chassis and the inside of the cabinet were not as successful.

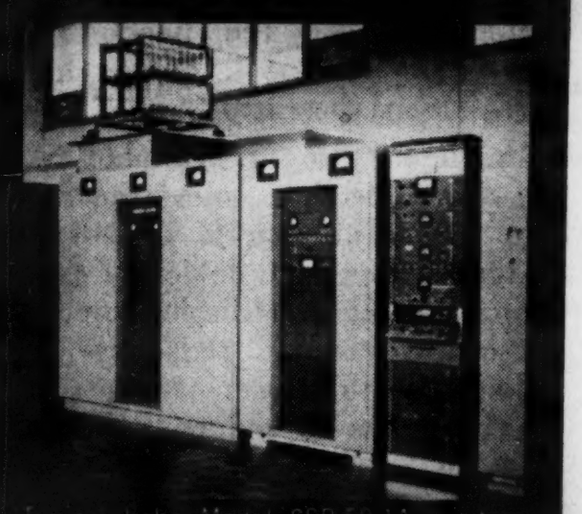
Intelligent use of available facilities for detecting interference can help the manufacturer improve the design of electronic devices. Environmental testing can disclose potential sources of radio frequency interference. The designer can then make improvements to reduce RFI to acceptable levels. Reduction of RFI gives the user a better instrument.

visit the afcea-signal booth 4226 at the ire show, march 20-23, nyc, and talk with members of AFCEA's National Headquarters and SIGNAL'S editorial staff.

MAJOR BREAKTHROUGH FOR HIGH and SUPERPOWER SSB

The Kahn Model SSB-58-1B high efficiency Class C SSB Exciter-Driver System, backed by more than 7½ years of continuous use, offers the first major breakthrough for high and superpower military and commercial SSB communications.

There are approximately seventy Kahn installations throughout the world, developing between 40 KW and 4 megawatts PEP.



Typical Kahn Model SSB-58-1A exciter-driver installation on 10 KW high-level AM Transmitter at Radio Swiss near Berne, Switzerland developing 40 KW PEP on SSB. Picture courtesy of Radio Swiss and Brown Boveri.

- 2½ times more power for a given plate dissipation — thus reducing overall SSB system cost, size, and weight.
- Greater sideband rejection at high and superpower levels.

KAHN RESEARCH LABORATORIES

KAHN RESEARCH LABORATORIES, Inc.

81 So. Bergen Place · Freeport, New York

FReeport 9-8800

Academy of Astronautics

(*Cont'd from page* 39)

nical programs of these meetings are concerned. Meetings initiated by the Academy, whether held in conjunction with the Congress or at other times and places would, of course, be the responsibility of the Academy. A proposal to UNESCO for a subvention for 1961-62 includes a meeting of a preliminary study group to be organized by the Academy for the purpose of determining the desirability and feasibility of holding a symposium in 1963 on the problems of "man in space."

(d) *Multi-lingual Handbook of Terms used in Space Research.* The Federation has for some time given its attention to the question of the definition in various languages of terms used in the field of extra-terrestrial space exploration. The Federation has requested financial assistance from UNESCO for the completion of this work in 1961-1962.

(e) *Consideration of the Establishment of an Academy Award and Fellowships.* During my discussions with the Daniel and Florence Guggenheim Foundation I mentioned that the Academy may wish to establish a medal or award of the highest international significance in the field of astronautics, possibly to be named after a leader or family which has made contributions of outstanding importance to the development of this field. The Academy may also wish to establish a post-graduate fellowship program and to direct its efforts toward finding funds for such a program. Subject to the approval of the Assembly of the Academy, I would recommend the setting up of an Academy Committee to study these questions and to present a report to the first regular meeting of the Academy in 1961."

Other Projects

The Academy has organized several working committees to carry on special projects. These include Finance, Publications, Academy Award and Fellowship, and Lunar International Laboratory Committees.

The Academy is also active in allied endeavors. At present the Director is continuing discussions with UNESCO with regard to a meeting in 1961 or 1962 which would consider the feasibility of holding a symposium in 1963 on the scientific and technical problems of "Man in Space." A Committee has been appointed to function in a Joint Commission of the Academy and the International Institute of Space Law on Technical Aspects of Space Law.

Polaris

(*Continued from page* 26)

fourteen fleet ballistic missile submarines, two tenders, auxiliary vessels supporting development and procurement of long lead time components for five additional submarines to be started in fiscal year 1962.

Research, development, test and evaluation for missiles and submarine weapons system components are being covered by $1.475 billion. Procurement of missiles and related ordnance costs, including operational missiles and submarines is being provided for by $.617 billion. Construction of military facilities, including communications, training and logistic support, is carried out under $.108 billion. Miscellaneous supporting projects are provided for by $.058 billion.

The Navy is aiming for forty-five fleet ballistic missiles submarines "as soon as we can have them," according to Rear Admiral Raborn. It is estimated that one Polaris missile, including spares and components for surveillance and testing, costs about $1.3 million, although this cost is trending downwards even while improved versions are extending range and performance. At this rate, sixteen missiles for one submarine would cost roughly $16,192,000 at base cost of $1,012,000 per missile. The Navy has stressed the relative low cost of the Polaris program, by stating that the initial cost of a submarine can be amortized over the 15 year period that the ship is believed to have a useful life. The Navy also has said that the annual operating costs of the ships are low; therefore, more funds would be available for other uses.

V. Conclusion

Representing the combined efforts of more than 6,900 contractors working under the supervision of the Special Projects Office, the Polaris weapons system offers the advantages of unfettered mobility and concealment not previously found in a weapons system. A Polaris-firing submarine can discharge its missiles from constantly changing positions while remaining submerged and out of detection range of an enemy. Thus, it may be that the United States will want to re-evaluate its various weapons systems with the intent of possibly placing greater emphasis upon such systems as Polaris. Also, it may be that knowledge gained from the operational Polaris system will be incorporated in the research, design and development of future weapons systems.

A SIGNAL STAFF REPORT

STARCOM EAST COAST RELAY SYSTEM COMPLETED

The U. S. Army Signal Corps marked the climax of its Centennial Year on December 15th with the dedication of the East Coast Relay Station at Fort Detrick, Maryland. The installation, completed at a cost of $25 million, is the latest strategic teletypewriter switching center in the Army's global communications network.

Maj. Gen. R. T. Nelson, USA, CSig O, (facing camera, L.) and RAdm. W. D. Irvin, USN, Chief, Defense Communications Agency, (facing camera, R.) at dedication ceremonies.

The following remarks were made by the Chief Signal Officer of the U. S. Army, Maj. Gen. R. T. Nelson, at the dedication ceremonies.

"This new East Coast Relay Station of the U.S. Army at Fort Detrick, Maryland, is the control station for the STrategic ARmy COMmunication System, or STARCOM, our global communications network. It is a modern approach to the world-wide communications needs of U.S. combat and peace time forces here and abroad. Together with STARCOM, which it controls, it gives us a communications capability for national defense such as we have never had before.

"As the largest automatic communications relay station in the world, it can handle 275,000 messages a day and store 5,000 at the same time. It has long distance radio, cable and wire channels to provide teletypewriter, voice, data, facsimile and other services throughout the United States and to internationally vital overseas locations. Automatic switching facilities do the work formerly done manually and a message can be sent through the station in three seconds.

"As the network control station for STARCOM, the station may eventually be part of the Defense Communications Agency facilities. Already it is handling messages for the Navy, Air Force, State Department and other Government agencies.

"It is also a major Army relay station and connects the United States with commands throughout the Atlantic and Western Hemisphere. An automatic relay station at Davis, California (completed in 1956), links the United States with Army commands in the Pacific and the Eastern Hemisphere. Another, at Fort Leavenworth, Kansas (completed February 1960), serves as a strategic hub for domestic and overseas communications. These relay stations complement each other's capabilities so that destruction or partial loss of one can be immediately compensated for by the other two.

"These relay stations are a practical and efficient consolidation of communications required between our Army installations in the United States. Instead of separate facilities for connecting each command, one with the other, the required communications are provided by these three large relay centers. Through any one of these, a major command can reach a desired headquarters any place in the world.

"Since the modern Army facility at Fort Detrick is the keystone of our global communications network, the choice of this community for its location was not accidental. It is near enough to Washington and the Pentagon to be strategically effective and yet far enough away to satisfy dispersal of essential government operations. It is also ideally suited with respect to the availability of commercial facilities.

"We in the Army Signal Corps are proud to have this station operational this year, which marks one hundred years of our Corps' existence. It is especially significant today because the need for fast, secure and dependable communications has never been so urgent. Our world continues to shrink and today's requirement for flexible and expandable communications combat support and effective command control is the most compelling in our country's history. The Strategic Army Forces upon whom we depend so much to repel aggression or to meet brush-fire conflicts which continue to plague the world, must be ready to 'take-off' on very short notice to wherever trouble may occur. Our overseas Army forces must be equally ready in their roles. The Signal Corps must support them with communications whenever they are called upon—any time, any kind of warfare.

"The combination of international unrest and tremendously improved firepower and mobility makes anything less than a global capability in communications unthinkable. Time, and the amount of it needed to get the word to the proper place, is both an obstacle and an asset. Our efforts toward speed in communications—to make time *our* asset—is in the high degree of automation which this and its companion facilities possess.

"While this modern station uses some of the latest operational advances in the art, it must be quickly adaptable to new developments and techniques. In its design, we have taken into account today's advances in communications technology and those which might be over the tech-

nical horizon. One example is the teletypewriter and punch tape facilities which are very similar to those input facilities used by the Courier satellite ground stations. We have always considered communications satellites as natural corollaries of our ground stations. We have kept in mind *compatibility* as well as *integration* with future developments in military space communications technology, with which the Army is charged.

"Without the close cooperation that existed between the Signal Corps, the Engineer Corps, and Industry, the successful completion of this project could not have been achieved. Automatic switching and routing of messages in this station employs equipment designed and produced by the Automatic Electric Company. High speed teletypewriter components were produced by the Kleinschmidt Division of Smith-Corona Marchant. The tropopheric scatter radio facilities were developed and provided by th Collins Radio Corporation."

Editorial Comment

(In addition to the remarks abov by General Nelson, the following dat is presented for your information.)

The ultra-modern, 200-line syste links the United States with com mands throughout the Atlantic an Western Hemisphere. The center re places the out-moded "torn-tape" sys tem now in use in the Pentagon an serves as a consolidation of many o the communications centers at Eas Coast Army bases and government Centers.

The system was designed to be highly flexible from both operational and maintenance standpoints. Equipment can be shifted easily from one line to another within the office, permitting maintenance without disruption of operations, an engineered expansion plan is also incorporated to permit a 25% system without disturbing the basic equipment layout.

A unique feature of the system is its ability to act immediately on any message arriving at the switching center. As soon as a normal message comes into the center, it is switched without delay to a cross-office position marked 'inter-office switching equipment." This keeps incoming lines free to receive high precedence messages. (There are six degrees of message priority.)

A "break-in" device allows automatic cancellation of messages of lower precedence and allows urgent messages to gain access to outgoing lines. The message which was interrupted requires only a minor manual operation for its re-transmission.

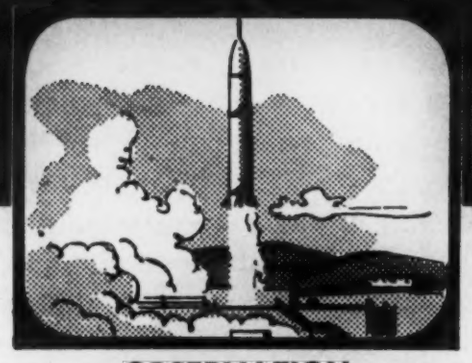
Multiple-call messages—those being sent to more than one station—are handled so that the outgoing messages are sent independently of each other, and are handled according to order of priority.

Incoming and outgoing line transmission may be at either of two speeds, 60 or 100 words per minute. The two speeds may be used simultaneously.

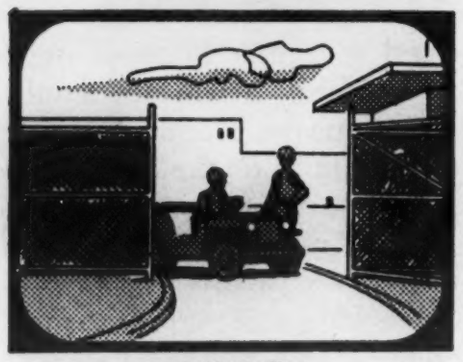
A high degree of message security is maintained since each message is individually safeguarded to its path through the center. Special alarm circuits indicate nearly every possible abnormal function of the equipment. The alarm circuits and traffic indicators are located at a supervisory position, allowing the entire switching center to be controlled by one supervisor.

PHILCO

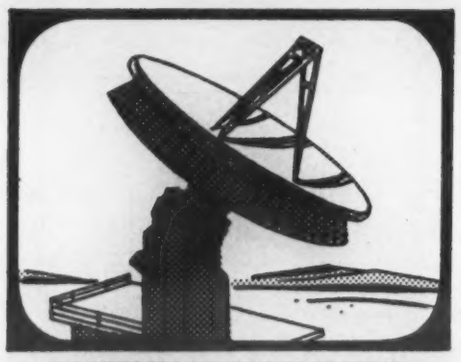
CLOSED CIRCUIT TV SYSTEMS SERVING THE MILITARY



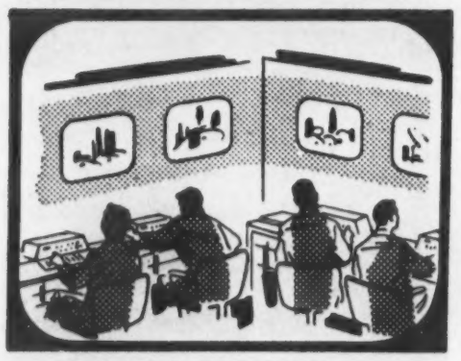
OBSERVATION



SECURITY



ANTENNA ALIGNMENT



DATA TRANSFER

Philco closed circuit TV systems are being widely used by the Military for many diverse applications . . . remote observation of missile launchings . . . gate watching . . . area perimeter surveillance . . . data transfer . . . visual communication . . . training programs. A Philco CCTV system is also being used to align satellite tracking antennas. Philco's extensive experience in closed circuit TV systems for military use is your assurance of obtaining the greatest flexibility and economy. Fully transistorized equipment guarantees maximum reliability, freedom from maintenance problems and ease of operation. Philco engineers will be glad to assist you in adapting closed circuit TV to your specific requirements.

Government & Industrial Group

4700 Wissahickon Ave., Philadelphia 44, Pa.

In Canada: Philco Corp. of Canada, Ltd., Don Mills, Ontario

PHILCO®

Famous for Quality the World Over

by GIFFORD HEFLEY
Radio Systems Division
National Bureau of Standards

TIMING POTENTIALS OF THE LORAN-C CLOCK

IN THE MAJORITY of timing applications a problem exists in setting two or more clocks to agree with one another. The greater the requirement for precise agreement between these clocks, the more difficult the problem becomes, and if the clocks are in widely separated locations the difficulty is further increased. The reading of a single clock is meaningful only as it relates to its own frame of reference. For example, a clock may gain or lose with respect to the periodicity of the earth as it revolves about its own axis or about the sun.

Accurate astronomical time depends on long-term observations, but is ultimately limited by unpredictable variations in the earth's rotation. Furthermore, any astronomical time can be determined only to an accuracy of several milliseconds for a single set of observations. The initial settings of individual clocks may, therefore, differ by amounts of the order of milliseconds. These differences combined with the gains or losses of individual clocks are of such magnitude that independently operating clocks or clocks synchronized by existing radio timing signals are unable to make measurements more precise than a millisecond at different locations.

When it is necessary to measure time at two or more locations to an accuracy of one microsecond or better, such measurements must all be made within the same frame of reference, that is within a single clock system. The term "clock system" as used here means a master clock at a convenient central location and other clocks at widely separated locations which are slaved to the master in such a way that each will track the master. Such a clock system must also provide for a means to synchronize or set each slave clock to agree accurately with the master clock.

The National Bureau of Standards (NBS) at Boulder, Colorado maintains the nation's primary frequency standard. A fail safe clock operating from this standard would provide an extremely uniform time source that could be related in retrospect to any astronomical time measurements. This uniform time source is the proposed means for controlling the aforementioned master clock.

In studies sponsored by the Ground Electronics Engineering and Installation Agency (GEEIA) of the Air Force, scientists at the Boulder Laboratories have made an adaptation which utilizes signals from the existing long-range navigation system, Loran-C,[1] to synchronize and set widely separated clocks to a relative accuracy closer than a millionth of a second. The Loran-C clock system consists of a master clock at a convenient central location and other clocks at widely separated locations which are slaved to the master in such a way that each will track the master. The system provides for a means to synchronize or set each slave clock to agree accurately with the master.

The Loran-C clock makes use of Loran-C navigation system for the stable transmission of timing signals. This system provides accuracies 1000 times greater than presently available from WWV.[2] A unique and important consideration is that no clock within the system can gain or lose with respect to any other clock.

Loran-C is an operational pulse navigation system utilizing a carrier frequency of 100 Kc. A chain normally consists of a master station and two or three slave stations. Three Loran-C chains are now in operation and others are under construction. The stations comprising the U. S. East Coast chain are located at Carolina Beach, North Carolina (master), Jupiter Inlet, Florida and Martha's Vineyard, Massachusetts. The area over which a ground wave can normally be received for timing purposes extends approximately 2,000 miles seaward and 1,500 miles over land from any one transmitter.

The Loran-C system utilizes synchronous detection techniques and methods for determining a fixed sampling point early on the pulse which is independent of pulse amplitude. By this means the ground wave is completely resolved from the sky waves. To a first approximation the ground wave transmission time is proportional to distance. Secondary corrections, however, usually have a magnitude in the range of 1 to 10 microseconds. This correction is determined largely by the conductivity of the path and to a much smaller extent by the dielectric constant and the index of atmospheric refraction. Both the conductivity and the dielectric constant of sea water are accurately known. Consequently, the transmission time over sea water can be computed accurately. Transmission times over paths involving land cannot be so accurately calculated because, in most cases, the conductivity of land is not well known. However, experience in correlating time difference measurements with generalized assumptions of ground conductivity is valuable. For example, it has been demonstrated that the best single value which can be assigned to the eastern half of the United States is 0.005 mhos/meter. The average error between time differences computed using this conductivity and those measured was approximately 0.8 microseconds. The algebraic average was nearly zero and the maximum error among all sites was 2.5 microseconds. The largest errors were associated with sites located in mountainous terrain. Until better prediction methods are

developed it must be assumed that systematic errors of the order of one microsecond may exist in land and mixed paths unless the transmission time has been measured independently.

The same computations used to predict the navigational grid are used to determine the difference between correct and apparent time at any given location. For example: if the signals are transmitted on time they will arrive at the clock later by a precisely calculable amount. Each clock can therefore be set in accordance with its location relative to the transmitter. All clocks set in this manner will be in mutual agreement.

East Coast Chain

The East Coast Loran-C chain operates on a basic repetition rate of twenty pulse groups per second. A pulse group consists of eight phase coded pulses with a uniform spacing of one millisecond. The Loran-C system, as presently operated, does not resolve time increments larger than the repetition period or 50 milliseconds. Larger increments could be resolved without interference to the system, but at this time there appears to be no pressing requirement for such a change. The 50 millisecond interval between pulse groups can be resolved conveniently by the WWV seconds' pulses. In order to use WWV and Loran-C in such a manner the two transmitting systems must be synchronized.

Where clocks are run from separate and independent oscillators they will gain or lose with respect to each other in accordance with the stability and accuracy of the oscillators. Even oscillators using atomic resonance phenomena do not produce identical frequencies. This undesirable aspect is completely side-stepped in the Loran-C clock.

By virtue of the technique of slaving a number of relatively poor oscillators to a master oscillator, all clocks operated from such oscillators will, by definition, have an average drift rate of zero. The instantaneous deviation of any one clock from the average is primarily determined by the factors listed below:

1. Signal-to-noise ratio.
2. Relative and absolute quality of slave and master oscillators.
3. Integration time.
4. Tightness of coupling of the slave oscillator.

Under ordinary circumstances the instantaneous deviations are less than 0.1 microseconds.

Assume a clock operating from the slaved oscillator of a Loran-C receiver is correctly set. If that clock and receiver are moved a distance of 983 feet toward the Loran-C transmitter the clock will then be one microsecond fast. Similarly, if the clock is moved 983 feet in the opposite direction it will be one microsecond slow. In contrast, if the same clock were operating from an independent oscillator it would neither gain nor lose as a result of motion.

If a Loran-C clock is used in a moving vehicle its position must always be taken into account. In either ships or aircraft the fixes available from the Loran-C navigation system can provide the necessary information. However, the computations required to convert the time difference readings to distance from the transmitters are rather involved and would necessitate a computer in most cases. However, in a stationary location the time and position can be determined more easily.

On the surface it might appear that an independent clock would be more satisfactory in a moving vehicle. This may be true in some cases provided the clock does not have to maintain synchronization with other clocks. In cases where drifts of the order of a microsecond are important, the slaved clock is a virtual necessity.

In examining a developmental model of a Loran-C clock, the panel immediately above the oscilloscope contains a 15 digit visual display of the usual increments of time from 1 microsecond to hundreds of days. When the clock is given a read command the time of occurrence of that command is displayed on the panel and is held until the next read command is received. A high speed photographic read out which can operate at intervals of 200 microseconds is arranged in parallel with the visual read out. Solid state techniques were utilized wherever possible in the clock design.

Simultaneous Position and Time

Loran-C, as a navigation and timing system, can provide both position and time simultaneously. This factor is considered a long step forward in improving the accuracy of guided missiles, space rockets, and the quality of data returned to tracking stations from satellites. The Loran-C system is being considered for interrange timing synchronization, providing not only a needed link between the Atlantic and Pacific Missile Ranges but also an excellent navigational system over the continental United States. An existing chain of ground stations would be used to receive a radio signal from a satellite

For that R E ®

NEW IDEA

visit the

IRE SHOW

March 20-23, 1961 New York

Coliseum and Waldorf-Astoria Hotel

Members $1.00, Non-members $3.00 Age limit—over 18

(or other space vehicle) at four or more points on earth. The position of the vehicle would be computed from the difference in the signal's time of arrival at each of these points. Irregularities in the atmosphere do affect the time of travel from satellite to earth but this error is much less than the changes in direction of travel. For purposes of space navigation the time error is practically negligible. According to NBS studies, the maximum error created by the atmosphere in the length of a radio path (and thus travel time from point to point) is 132 feet if the signal is three degrees above the horizon. This error is imposed by outer space—and therefore the size of the error does not increase once the object is outside the atmosphere. For a larger angle of elevation this error would be smaller as the radio wave would travel through less of the earth's atmosphere. Accuracy of the NBS system is governed primarily by the distance between the receiving stations and the accuracy of time synchronization among these stations.

To get a good fix on the satellite it is important that the tracking stations be widely separated. If they were all within a hundred miles of each other, the signal would arrive at all stations practically simultaneously. The difference in the signal's time of arrival at each station can be more clearly measured if the stations are hundreds or thousands of miles apart. However, a radio signal travels at just about the speed of light or 186,000 miles a second. To measure the difference in its time of arrival at several different points on earth—even when they are widely separated —requires the ability to measure time to a great accuracy with precise synchronization of the clocks at each tracking station. By using the Loran-C clock one would be able to measure a time signal with millionth-of-a-second accuracy within 1500 miles over the ocean and 1200 miles over land from any one of the U. S. East Coast chain of transmitters. For purposes of space navigation this would provide stations thousands of miles apart yet synchronized within a millionth of a second or better. It is entirely feasible to synchronize two or more Loran-C chains and thus synchronize tracking stations on opposite sides of the globe with only slightly less accuracy.

At the invitation of Dr. Hugh L. Dryden, Director of the National Aeronautics and Space Administration, Robert Linfield and the author, of the NBS Central Radio Propagation Laboratory, described the Loran-C clock system and its application to space navigation at a meeting of the NATO Advisory Group for Aeronautical Research and Development (AGARD) in Istanbul last October. Robert Doherty, E. L. Berger and T. L. Davis, all of NBS, used two Loran-C clocks on the Atlantic Missile Range chain last Fall to demonstrate their accuracy for military observers.

Scientific and Commercial Uses

Additional scientific and commercial uses of a precise timing system with direct or indirect military applications are:

- The positioning of high-altitude aircraft from the ground by using the UHF pulse technique.
- The location of thunderstorms by precisely measuring the location of lightning discharge.
- The accurate position-fixing of nuclear detonations by a similar means.
- A precise evaluation of the fluctuations of the periodicity of the earth's rotation and other astronomical phenomena by relating observations made at widely separated points.
- The precise measurement of time variations on high frequency transmissions such as WWV as an aid to better understanding of propagation phenomena. Similar measurements on forward scatter communication links and other types of communication are possible.
- The surveying of offshore islands and remote areas.
- The investigation of Loran-C sky waves to give a better understanding of low frequency ionospheric conditions.
- The precise time from a single Loran-C clock could be made economically feasible for a variety of users in industry and research by the application of VHF or UHF distribution systems. Relatively inexpensive receivers would result if sufficient users were located within range of the distribution system. Existing facilities such as TV transmitters could be used for this purpose.

[1]See SIGNAL, April, 1960—p. 53.

[2]WWV is the NBS radio transmitting station near Washington, D. C. for broadcasting standard radio frequencies of high accuracy. WWV broadcasts are on 2.5, 5, 10, 15, 20 and 25 mc/sec. The frequency signals are modulated by pulses at 1 cps.

Role of Electronics

(*Continued from page* 8)

unlikely that any nation would start an all-out war.

Although these supersaturated forces of destruction probably constitute an excellent deterrent to nuclear attack on this country—and, incidentally, provide a tremendous incentive for the negotiation of world disarmament—it does not appear that they will significantly deter the outbreak of limited wars. It is inconceivable that any nation would risk almost certain destruction of its civilization by employing such forces in limited military conflicts. This means that our tremendous investment in bombers and ICBMs will probably not keep the Soviet from continuing to nibble away, even using military force, at its long-range objective of world communism.

But, if we could definitely break this growing deterrent stalemate by acquiring some radically new weapons that would give us an overwhelming military advantage, we could not only deter all-out attack against us but might discourage continued aggression on a limited scale.

One thing that could break the balance of deterrent forces would be a truly effective system of defense against them—not one that would merely stimulate the opposition to build and deploy more missiles in an effort to re-establish the balance, but a defense system, including fall-out shelters, that could effectively protect our military, industrial and population centers against a massive, all-out attack. Almost surely the nation that first achieves such a defense would have a tremendous military and political advantage, at least until methods of countering the defense were developed or until both sides had equally effective defenses.

This discussion of total defense against ballistic missiles illustrates my point concerning the potential importance of radically new weapons based on new technology. Obviously, this is only one area where such new weapons could exert a significant and, perhaps, decisive influence on the balance of power between East and West.

In tactical warfare radically new weapons could also be extremely valuable. As I said before, it is unlikely that our strategic thermonuclear forces will prevent aggressive acts of a limited nature on the part of the communists. It is essential, therefore, that the tactical forces of our Army, Navy and Air Force be kept always at the highest possible level of efficiency. To this end, these forces should have ready to use the most advanced weapons that our scientists and engineers can provide.

Also in the area of command and control we urgently need new systems based on new concepts and new techniques. The requirements for reliability, capacity and reaction times in command and control have advanced so rapidly with the growth of weapon capabilities that current computer and communications technology is not fully adequate to meet these system needs.

The Role of Space

Our space programs also demand electronic components and techniques that we do not have at present. I am not sure just where space activities fit into the involved picture of competition for world supremacy. It is evident that satellites orbiting the earth have great potentialities for military use in communications, navigation, warning and surveillance and various defense agencies are vigorously pursuing extensive programs in these areas. Probably other space ventures—putting "man in space", probing the moon or planets or embarking on journeys beyond our own solar system—will profoundly affect our national prestige throughout the world. But the military implications of these ventures are not clear. Still we cannot afford to shut our eyes to these programs, nor to the revolting possibility that space—even outer space—may some day represent another dimension of man's battlefield. It is conceivable, for example, that space systems apart from the provision of early warning, might play an important role in establishing a fully effective defense against ballistic missiles such as I mentioned earlier. I just don't know how these things will develop—and I am not sure that anyone else knows.

To reiterate the point I have been making for the past few minutes: Radically new weapons and systems can profoundly and, perhaps, decisively influence the balance of power between the communist and free worlds. *Indeed it is entirely possible that a single fundamentally new weapon could be the determining factor in our civilization's survival in the coming decades.* But any such weapon will almost certainly come out of new technology rather than refinements based on current weapon approaches. Accordingly, I consider it imperative that this nation shift an appreciable amount of its scientific and engineering resources from the task of developing generation after generation of weapons that only marginally increase our total strength to the task of research and technical development on which to base the new concepts and new techniques—and, possibly, the technological breakthroughs—that will make possible the development of decisive new weapons.

Great Technological Advances to Come

Since electronics is now the most important single technology in weaponry, it is clear to me that this area should encompass the greatest expansion of this fundamental technological effort. I would expect to see in the broad area of electronics some of the great technological advances and breakthroughs that will have significant impact on our future military capability. I can't forsee what those breakthroughs will be, nor when they will occur, nor what effect they will have on the balance of world power. I *can* say, however, that throughout the country some pretty exciting things are going on in electronics research laboratories. Here are some of them: The generation and amplification of coherent light; computers that can learn and possibly "think;" microwave generators with outputs measured in megawatts of average power; thermionic power conversion, new methods of radio transmission wherein all system elements, including the antenna, are hundreds of feet below the earth's surface; revolutionary concepts of solid state and cryogenic electronics that may make it possible to house in the limited volume of a space vehicle a computer with the capability of the SAGE system. Some of the many new avenues of electronics research now opening up may hold the secret of a new force that could give us the desired unchallengeable lead over communism.

But, unless we put more national emphasis on research and exploratory development in electronics—and I want particularly to stress the need for additional emphasis on exploratory development—these and other promising technological advances in electronics will be far too long in coming to fruition. It is not enough to expand our storehouse of knowledge through a broadened and accelerated program of fundamental research. We must carry out the applied research or exploratory development that is necessary to prove that it is feasible to apply this new knowledge to some new weapon concept. Otherwise, it may remain in the archives of scientific literature unused, perhaps forgotten by the developers of weapon systems, that is, unless it is found and used by the Soviet.

Summary

Now let me summarize the points I have attempted to bring out.

First, electronics is probably the most important and most critical area of technology affecting the development of all weapons and command and control systems.

Second, our future military strength and perhaps, our national survival may depend upon weapons that are radically new and are based on advanced or new technology rather than weapons that are mainly "warmed-over" versions of weapons now in existence or well along in development.

Third, there is an urgent need to shift a substantial portion of our scientific and engineering resources from weapons development to research and particularly to exploratory development.

Finally, because electronics is so widely used in all military weapons and control systems, a major technological advance in this area may lead to a new weapon concept that will give this country a decisive military advantage.

In closing, I would like to say that I hope and pray—as I am sure most Americans do—that a way can be found at the conference table to solve the grave problems at the root of world tension. If the contest in weapons development continues between two nations so rich in industrial and scientific resources as the U. S. and the U.S.S.R.. the result will be not only a persistent and increasing drain on our civilian economy, in both dollars and scientific manpower, but a steady increase in the danger of worldwide destruction.

Speaking in Syracuse four years ago, I expressed the hope that the challenge to all mankind to conquer space would be so great that his desire to fight among his own kind would disappear. I am afraid this was merely wishful thinking. In realitv, the space programs of the United States and the U.S.S.R. have had the effect of intensifying international rivalry rather than stimulating cooperative endeavors in scientific exploration.

We must keep hoping for, and working toward, a political or sociological kind of breakthrough that will lead to permanent peace among the great powers of the earth. At the same time, we must seek the technological breakthroughs that will enable us to keep our armed services strong enough to deter military aggression on all fronts until it is possible to bring about the disarmament of nations in a safe and generally acceptable manner.

Managing Our Resources

(*Continued from page 22*)

their efficiency compared to others.

As a small start on solving this problem the Air Force and one of our Departments at General Electric are trying a new type of Research and Development Contract which allows us to measure at least in part the performance of a large group of engineers, scientists, and production workers concerned with the development and manufacture of highly complex ballistic missile re-entry vehicles. This contract provides performance incentives and penalties based on a large number of measurable quantitive factors in a creative development program. Just how well this will work remains to be seen but I mention it to emphasize that we must apply innovation in all fields of business and government if we are to continue our country's growth at an ever accelerating pace.

We must remember that the weapons and products are *necessarily* becoming more complex and learn not to fear that complexity, but to use it and to manage it. There are few more complex activities in all of human endeavor than that of the development and launching of a space vehicle and then recovering its contents from space. We must remember that the greatest simplifying factor in the conduct of a complex program is the use of complex technology. No one would think of performing a complex function like all-out mobilization of the nation for war without the use of the telephone. But can you imagine a more complex technology than that involved in the national network of telephones? Keep in mind that a complex product may often enable a simpler solution of a more complex problem. Manage this complexity so that it will work for you.

We must also remember the shortened time scales and always use today's and tomorrow's technology rather than yesterday's, always bearing in mind that a long step-by-step program can result in a product or weapon that is obsolete before it has served a useful purpose.

If I can leave just one final thought, it is that we must wholeheartedly address ourselves to the fundamental challenge of creatively managing and using our vast resources of knowledge to accelerate these trends rather than dissipating our energy by opposing them, to understand them fully—then American growth and leadership will continue on far, far into the future.

Combination Set—Send-Receive Page Printer, Tape Punch and Tape Reader

Which Teletype printer is best for you?

Which of these Teletype Model 28 page printers is best for your message and data communications needs? Each will perform the basic function of all Teletype equipment—to flash information over long or short distances. But in addition, each has varying capabilities to meet the requirements of the individual user:

Send-receive page printer in console—probably Teletype's most familiar product; for sending as well as receiving page copy.

Receive-only page printer in console—the same machine, but without a keyboard. For use where information need only be received, not sent. No operator is required.

Table model — with or without keyboard . . . similar model available for rack mounting.

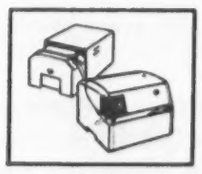
Combination set — a complete message center in one compact cabinet. In addition to page printer and keyboard, it contains facilities for preparing punched tape and for transmitting and receiving via tape.

All of these Teletype Model 28 page printers feature the Stunt Box, a built-in "programming" mechanism that will inexpensively handle a wide variety of remote control and switching tasks such as automatic station selection. All models can be supplied with sprocket-feed and tabulating mechanisms for use with multi-copy business forms. All are available, too, in a choice of cabinet colors to match office decor.

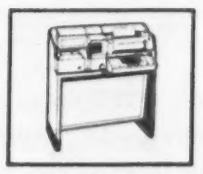
Teletype Corporation manufactures this equipment for the Bell System and others who require the utmost reliability from their data communications. Teletype equipment can be used with Data-Phone and other communications services.

Free Model 28 Line folder. Write Dept. 76-B, 5555 Touhy Avenue, Skokie, Illinois

TELETYPE®
CORPORATION • SUBSIDIARY OF *Western Electric Company* INC.


Tape Reader and Typing Tape Punch

Send-Receive Page Printer


Automatic Send-Receive Set

A Rose By Any Other Name

This is the second in a series of articles which SIGNAL *will publish on defense supply management. The material is being made available by the Office of the Assistant Secretary of the Army (Logistics).*

UNDER ANY NAME, a rose would be a rose in the Federal Catalog System. The single number which identifies each item in the catalog has 11 digits, just the number required to add up the multi-billion dollar savings made possible by this defense management tool.

One item—one catalog number was not always the rule of the road in the government. Short years ago, during the Korean war, there were 27 different catalog numbering systems in the Defense Department alone, with other federal agencies adding to the confusion of multiple supply languages. Each agency assigned its own catalog numbers to items carried in stock and the number for a pencil in one system could be the number for a generator in another system. Borrowing an aviation engine part or even a screwdriver from a neighboring agency was a well nigh impossible task when few talked the same language of supply.

Making one system out of 27 different systems was not an easy task. Congress recognized the need and passed the Defense Cataloging and Standardization Act which was effective on July 1, 1952. At that time it was impossible to compute how many actually different items were being bought, stored and used under the multiplicity of existing numbers. Congress and the military roughly estimated that there were 4 to 5 million actually different items in the system. The average Sears Roebuck Catalog contains about 100,000 items.

Six years later, in 1958, after the biggest describing, identifying, numbering and record conversion job in history, there was a single catalog in use throughout the military supply system. During the six year period and in response to the tremendous technological breakthroughs of the times, new items were entering the system at a rate of 500,000 per year. Yet, when the catalog was completed, converted to use, and the totals computed, only 3.4 million separately numbered items were listed. The multiple numbered screwdriver was listed under one common number and the neighbor's storeroom was available for community use.

Nerve center of the Federal Catalog System is the Defense Department's Armed Forces Supply Support Center. On a huge electronic computer in the Center all items in the federal catalog, whether defense or other government agency items, are recorded on magnetic tape or punch cards. The central electronic memory knows who uses what item, the various manufacturers' part numbers, the item specifications, the type of packaging, and the right freight classification code to assure the lowest transportation cost to the government. Fanning out from the Center to each inventory manager in Defense is a wire transmission rapid communications network which speeds information on each proposed procurement and on the availability of community owned storeroom material.

To the thousands of customer installations, ships, troop units, and air squadrons go tailored catalogs which list items required to support their combat equipment and their daily operational needs. The inventory manager for electronic parts, for example, sends a catalog to each major ship in the Navy, listing the parts necessary to support the specific electronic equipments on the ship. Catalogs tailored to fit the needs of the user save money by restricting the selection of items to the necessary rather than the desirable. The tailoring of the catalog is done by technicians whose work saves the military operator countless hours of research. The book catalogs are printed from the master card and tape file kept up-to-date by the Armed Forces Supply Support Center.

The American taxpayer has invested more than $150 million in the development of the single catalog system. It has proved to be a worthwhile investment which has returned many times the initial cost.

The management payoff is being realized. The single catalog with its common supply language is the key which unlocks all military storerooms for community use. In the year just ended, the requirements of military users were matched against storeroom stocks of other military users at a record rate and almost $2 billion of supplies were transferred for use. This was a direct savings in taxpayers dollars for new purchases.

The catalog key to the neighbor's storeroom also unlocks the door to the warehouse stocks of the General Services Administration. The GSA provides common supplies to all government agencies and, with the ability to identify supplies in the single catalog, the use of the GSA has shown a marked increase. The Defense Department last year bought more than one half billion dollars worth of supplies through the GSA and eliminated the need to carry duplicate wholesale stocks in military warehouses.

With the completion of the single catalog, the Single Manager System is being extended to eight major commodity groups with 1,200,000 items. A defense Single Manager buys, manages, stores and issues supplies in a given commodity for all military users. Duplicate wholesale inventories, distribution systems and inventory management offices are eliminated. Without the common catalog language as a tool for management such widespread integration of supply is not possible. As yet only in its growing stage, the Single Manager System lists savings of $400 million to date.

The single catalog allows for consolidated purchasing with the requirements of all users bought at one time by one agency. Used in addition to the Single Manager System. the single department procurement program reaps benefits from better prices, reduced paperwork and improved industry relationships. Billions of dollars in defense procurement are handled under coordinated procurement each year.

In the three year period after catalog completion, military inventories have been reduced by $10 billion. The effectiveness of military supply has increased in all areas and unification of supply has become a reality. The tool which cost the equivalent of a Polaris submarine has saved enough to buy a fleet of submarines and the savings will increase year after year.

AFCEA Sustaining and Group Members

Communications—Electronics—Photography

Listed below are the firms who are sustaining and group members of the Armed Forces Communications and Electronics Association. By their membership they indicate their readiness for their share in industry's part in national security. Each firm nominates several of its key employees or officials for individual membership in AFCEA, thus forming a group of the highest trained men in the electronics and photographic fields, available for advice and assistance to the armed services on research, development, manufacturing, procurement, and operation.

Sustaining Members

American Telephone & Telegraph Co., Long Lines Department
Cook Electric Co.
General Electric Co., Defense Electronics Div.
International Telephone & Telegraph Corp.
New York Telephone Co.
Radio Corporation of America
Western Electric Co., Inc.

Group Members

Adler Electronics, Inc.
Admiral Corp.
Allied Control Co., Inc.
Allied Radio Corp.
American Cable & Radio Corp.
American Institute of Electrical Engineers
American Machine & Foundry Co.
American Radio Relay League, The
American Telephone & Telegraph Co.
Amphenol/Borg Electronics Corp.
Anaconda Wire & Cable Co.
Andrew Corp.
Ansco Division, General Aniline & Film Corp.
Arnold Engineering Co., The
Associated Electrical Industries Ltd.
Automatic Electric Co.
Automatic Electric Sales Corp.
Automatic Telephone & Electric Co. Ltd.
Autonetics, Division of North American Aviation, Inc.
Barry Controls Inc.
Bell Telephone Company of Pennsylvania, The
Bell Telephone Laboratories Inc.
Bendix Radio Division, The Bendix Corp.
Bendix Systems Division, The Bendix Corp.
Bliley Electric Co.
Bruno-New York Industries Corp.
Budd Electronics, Inc.
Burroughs Corp.
California Water & Telephone Co.
Cambridge Thermionic Corp.
Capitol Radio Engineering Institute, Inc.
Carolina Telephone & Telegraph Co.
Central Technical Institute
Chesapeake & Potomac Tel. Co., The
Cincinnati & Suburban Bell Tel. Co., The
Collins Radio Co.
Columbia Broadcasting System, Inc.
Comptometer Corp.
Contraves Italiana S.p.A.
Convair/Pomona, Convair Division of General Dynamics Corp.
William C. Copp & Associates
Copperweld Steel Co.
Cornell-Dubilier Electric Corp.
A. C. Cossor Ltd.
Craig Systems, Inc.
Crosley Division, Avco Corp.
Decca Navigator Co. Ltd.
Delco Radio Division, General Motors Corp.
Designers For Industry, Inc.
Developmental Engineering Corp.
Diamond State Telephone Co., The
Dictaphone Corp.
DuKane Corp.
Du Mont, Allen B., Laboratories, Div. of Fairchild Camera & Instrument Corp.
Eastman Kodak Co.
Electronic Associates, Inc.
Electronic Communications, Inc.
Elgin Metalformers Corp.
Fairchild Camera & Instrument Corp.
General Telephone & Electronics Corp.
Gilfillan Bros. Inc.
Gray Manufacturing Co., The
Hallamore Electronics Co.
Hallicrafters Co., The
Haloid Xerox Inc.
Hazeltine Electronics Division, Hazeltine Corp.
Heinemann Electric Co.
Hoffman Electronics Corp., Military Products Div.
Hughes Aircraft Co.
Illinois Bell Telephone Co.
Indiana Bell Telephone Co., Inc.
Institute of Radio Engineers
Instruments for Industry, Inc.
International Business Machines Corp.
International Resistance Co.
International Standard Engineering, Inc.
Jansky & Bailey, Inc.
Jerrold Electronics Corp.
Kleinschmidt, Division of Smith-Corona Marchant Inc.
Laboratory for Electronics, Inc.
Leich Sales Corp.
Lenkurt Electric Co., Inc.
Litton Industries, Inc.
Lockheed Aircraft Corporation
Loral Electronics Corp.
Machlett Laboratories, Inc., The
Magnavox Co., The
Marconi's Wireless Telegraph Co. Ltd.
Martin Co., The
Materiel Telephonique, Le
McCoy Electronics Co.
Melpar, Inc.
Michigan Bell Telephone Co.
Montgomery Co., The
Motorola Inc.
Mountain States Telephone & Telegraph Co., The
Mullard Ltd.
Muter Co., Rola & Jensen Divisions
Mycalex Corporation of America
National Co., Inc.
New England Tel. & Tel. Co.
New Jersey Bell Telephone Co.
North Electric Co.
Northrop Corporation
Northwestern Bell Telephone Co.
Oak Manufacturing Co.
Ohio Bell Telephone Co., The
Pacific Telephone & Telegraph Co., The
Packard-Bell Electronics Corp.
Page Communications Engineers, Inc.
Pan American World Airways, Inc.
Paraplegics Manufacturing Co., Inc.
Phelps Dodge Copper Products Corp.
Philco Corp.
Photographic Society of America
Plessey Co. Ltd., The
Prodelin Inc.
Radiation Inc.
Radio Corporation of America, Astro-Electronic Products Div.
Radio Corporation of America, Defense Electronic Products
Radio Engineering Laboratories, Inc.
Radio Frequency Laboratories, Inc.
Raytheon Co.
RCA Great Britain Ltd.
Red Bank Division, The Bendix Corp.
Reeves Instrument Corp.
Republic Aviation Corp.
Rixon Electronics, Inc.
Rocke International Corp.
Ryan Aeronautical Co.
Saxonburg Ceramics, Inc.
Scanner Corporation of America, Inc.
Singer Manufacturing Co., The Military Products Division
Society of Motion Picture & Television Engineers
Southern Bell Telephone & Telegraph Co.
Southern New England Telephone Co., The
Southwestern Bell Telephone Co.
Sperry Gyroscope Co., Division of Sperry Rand Corp.
Sprague Electric Co.
Stackpole Carbon Co.
Standard Electronics Co.
Standard Telephones & Cables Ltd.
Stanford Research Institute
Stewart-Warner Electronics, Div. of Stewart-Warner Corp.
Stromberg-Carlson Co., Division of General Dynamics Corp.
Surprenant Mfg. Co.
Sylvania Electric Products Inc.
Technical Materiel Corp., The
Telectro Industries Corp.
Tele-Dynamics Div., American Bosch Arma Corp.
Telephonics Corp.
Teleprinter Corp.
Teletype Corp.
Texas Instruments Incorporated
T.M.C. (Canada) Ltd.
Tung-Sol Electric Inc.
Union Carbide Corp.
United Telephone Co. of Missouri
United Transformer Corp.
Varian Associates
Vitro Electronics, Division of Vitro Corporation of America
Waterman Products Co., Inc.
Webcor, Inc., Electronics Division
West Coast Telephone Co.
Western Union Telegraph Co., The
Westinghouse Electric Corp.
Westrex Corp., a Division of Litton Industries, Inc.
Wheelock Signals, Inc.
Wilcox Electric Co., Inc.
Wisconsin Telephone Co.
Wollensak Optical Co.
Zenith Radio Corp.

Association affairs

NATIONAL OFFICERS

President
Benjamin H. Oliver, Jr.*

1st Vice President
Maj. Gen. Harold W. Grant, USAF*

2nd Vice President
Maj. Gen. R. T. Nelson, USA*

3rd Vice President
Rear Adm. Frank Virden, USN*

4th Vice President
Frank Stoner*

5th Vice President
Walter H. Pagenkopf*

General Manager
W. J. Baird

Secretary
F. T. Ostenberg

General Counsel
Frank W. Wozencraft

Treasurer
W. Earl Trantham

PERMANENT DIRECTORS

George W Bailey
Percy G. Black
Frederick R. Furth*†
Theodore S. Gary
William J. Halligan
Frederick R. Lack
Joseph R. Redman
David Sarnoff
W. Walter Watts

DIRECTORS

1961	1962	1963	1964
Harry E. Austin	Theodore L. Bartlett	Leonard D. Callahan	Francis L. Ankenbrandt
George I. Back	Maj. Gen. G. A. Blake, USAF	A. F. Cassevant	W. Preston Corderman
Roland C. Davies	Ben S. Gilmer*	Walter C. Hasselhorn	E. U. DaParma
E. K. Foster	Joseph E. Heinrich	Walter P. Marshall	George L. Haller
Francis H. Lanahan	John R. Howland*	Henry J. McDonald	Charles F. Horne
Paul S. Mirabito	Fred E. Moran	A. L. Pachynski	David R. Hull
Peter Schenk	Donald C. Power	William L. Roberts	John W. Inwood
Robert C. Sprague	Stephen H. Simpson	Ellery W. Stone	Walter K. MacAdam

**Executive Committee Member. †Immediate Past President.*

AFCEA CHAPTER ORGANIZATION

REGIONAL VICE PRESIDENTS AND CHAPTER OFFICERS

REGION A

Regional Vice President—G. D. Montgomery, AT&T Co., 32 Ave. of the Americas, New York, N. Y. ***New England States, New York, New Jersey.***

BOSTON: Pres.—Louis J. Dunham, Jr., Franklin Technical Institute, 41 Berkely St., Boston, Mass. Sec.—William Melanson, Cambridge Thermionics Corp., 447 Concord Ave., Cambridge.

FORT MONMOUTH: Pres.—Dr. Hans K. Ziegler, 213 Perrine Ave., Elberon, N. J. Sec.—Maj. Melvin F. Werksman, USAR, 7 Bauer Ave., Elberon, N. J.

LEXINGTON-CONCORD: Pres.—Lt. Col. D. V. Mayer, USAF, AMC Electronics System Center, L. G. Hanscom Field, Bedford, Mass. Sec.—1/Lt. J. Burkley, USAF, AMC Electronics System Center, L. G. Hanscom Field, Bedford, Mass.

NEW YORK: Pres.—G. D. Montgomery, AT&T Co., 32 Ave. of the Americas. Sec.—R. W. Kleinert, AT&T Co., 233 Broadway, Brooklyn, N. Y., N. Y.

NORTHEASTERN UNIVERSITY: Pres.—R. Zaruba, 66 Washington St., Wellesley, Mass. Sec.—M. Feerick, Jr., 96 Library St., Revere, Mass.

ROME-UTICA: Pres.—Lt. Col. M. Bobela, Hq. GEEIA, Box 123, Griffiss AFB, N. Y. Sec.—L. P. Chemlen, P.O. Box 247, Rome, N. Y.

SOUTHERN CONNECTICUT: Pres.—John N. Higgins, KIP Electronics Corp., 29 Holly Pl., Stamford, Conn. Sec.—J. A. Leopold, Dictaphone Corp., 375 Howard Ave., Bridgeport.

SYRACUSE: Pres.—Colin W. Getz, New York Telephone Co., 108 West Fayette St., Syracuse, N. Y. Sec.—John G. Labedz, Lyndon Road, Fayetteville, N. Y.

REGION B1

Regional Vice President — George C. Ruehl, Jr., Electronic Aids, Inc., 2118 St. Paul Street, Baltimore, Md. ***Delaware, District of Columbia, Maryland, Eastern Pennsylvania and Virginia.***

BALTIMORE: Pres. — Cdr. Bob Kirsten, USCG, U. S. Coast Guard Yard, Curtis Bay, Baltimore 26, Md. Sec.—Thomas E. Thompson, Jr., The Martin Company.

PHILADELPHIA: Pres.—Robert G. Swift, Bell Tel. Co. of Pa., 121 N. Broad St., Phila., Pa. Sec.—T. D. Callahan, Jr., Bell Tel. Co. of Pa., 1835 Arch St., Phila., Pa.

WASHINGTON: Pres.—K. B. Lewis, Eastman Kodak Co., 1000 Conn. Ave., Wash. 6, D. C. Sec.—H. A. Crossland, General Electric Co., 777 14th St., Wash. 5, D. C.

REGION B2

Regional Vice President—Paul H. Clark, Radio Corporation of America, 224 N. Wilkinson St., Dayton, Ohio. ***Kentucky, Ohio, West Virginia and Western Penn.***

CINCINNATI: Pres.—Ralph G. Edwards, American Tel. & Tel. Co., 1014 Vine St., Cincinnati 2, Ohio. Sec.—Henry Lemeur, 1329 Arlington St.

DAYTON-WRIGHT: Pres.—Col. Robert L. Salzarulo, USAF, 1148 Cloverfield Ave., Dayton, Ohio. Sec.—K. C. McClellan, 1st & Ludlow Sts., Talbott Bldg., Rm. 256, Dayton 2, Ohio.

LEXINGTON: Pres.—Maj. K. J. Holmes, Lexington Signal Depot, Lexington, Ky. Sec.—E. W. Galins, 201 Roman Rd.

PITTSBURGH: Pres.—R. H. Creps, Bell Tel. Co., 201 Stanwix St., Pgh. 22, Pa. Sec.—H. W. Shepard, Jr., 625 Stanwix St., Pgh.

REGION C

Regional Vice President—W. K. Mosley, Southern Bell T&T Co., Hurt Bldg., Atlanta, Ga. ***Southeastern States along Atlantic and Gulf coasts—from North Carolina to Louisiana including Tennessee.***

ATLANTA: Pres.— J. S. Seigle, Southern Tel. & Tel. Co., 805 Peachtree St., N. E., Atlanta, Ga. Sec.—M. S. Butler, P. O. Box 685, Atlanta Airport, Atlanta 20, Ga.

AUGUSTA-FORT GORDON: Pres. — Col. T. J. Trainor, Route 2, Box 1016, Augusta, Ga. Sec.—L/C H. T. Crowell, Hqs. Detachment (Television Branch) U. S. Army Southeastern Signal School, Ft. Gordon, Ga.

CAPE CANAVERAL: Pres.—Lt. Col. J. W. Kelly, USAF, 90 S. Poinciana Dr., Eau Gallie, Fla. Acting Sec.—W. S. Fincher, 141 Albatross Dr., Eau Gallie, Fla.

CENTRAL FLORIDA: Sec.—Russell R. Randell, 208 So. Manhattan Ave., Tampa, Fla.

GULF COAST: Pres.—H. D. Yund, 10 - 30th St., Gulfport, Miss. Sec.—R. C. Cox, Southern Bell, 500 Rich Ave., Gulfport, Miss.

LOUISIANA: Pres.—J. C. Morris, 206 Gibson Hall, Tulane U., 6823 St. Charles Ave., New Orleans 18. Sec.—W. J. de Armas, Jr., Southern Bell Tel. & Tel. Co., 520 Barronne St., New Orleans 13.

MONTGOMERY: Pres.—Lt. Col. Herbert Herman, Air Command & Staff College, Maxwell AFB, Ala. Sec.—Luther L. Hall, 3549 Cloverdale Rd., Montgomery, Ala.

NORTH CAROLINA: Pres:—J. F. Havens, Carolina Tel. and Tel. Co., Tarboro, N. C. Sec.—John C. Coley, Carolina Tel. and Tel. Co., 517 Hay Street, Fayetteville, N. C.

NORTHWEST FLORIDA: Pres.—Maj. Ray Kinslow, USAF, Air Proving Ground Center, 3201st ABW, Eglin Air Force Base, Fla. Sec.—Capt. Roy L. Stover, 4751st ABRON, Box 491, Eglin AF Aux. Fld. #9.

ORANGE: Pres.—Lt. Col. D. Dobbins, USAF (Ret.). Sec.—J. A. Trutter, 1013 Ensenada Dr., Orlando.

SOUTH CAROLINA: Pres.—H. L. Lackey, Southern Bell Tel. & Tel. Co., Columbia, S. C. Sec.—Donald D. Harris, Southern Bell T&T Co., Owen Bldg., Columbia, S. C.

REGION D

Regional Vice President—Maj. Gen. Harry Reichelderfer, USA (Ret.), Southwest Research Institute, 8500 Culebra Rd., San Antonio, Tex. ***New Mexico, Texas, Oklahoma, Arkansas.***

LAWTON-FORT SILL: Pres.—Col. R. Laskowsky, U. S. Army Artillery & Missile School, Fort Sill, Okla. Sec.—C. E. Warner, 208 N. 31st St., Lawton, Okla.

NORTH TEXAS: Pres.—R. T. Shiels, Anaconda Wire & Cable Co., 1201 Fidelity Union Life Bldg., Dallas 1. Sec.—Robert J. Novak, AT&T Co., 212 No. St. Paul St., Dallas.

SOUTH TEXAS: Pres.—Col. A. Burke, Hqs., 4th U. S. Army, Ft. Sam Houston, Texas. Sec.—W. Gillum, (same address).

TINKER-OKLAHOMA CITY: Pres.—R. E. Howard, Southwestern Bell Tel. Co., 405 N. Broadway, Oklahoma City, Okla. Sec.—G. Billy, 3406 Bella Vista, Midwest City, Okla.

WHITE SANDS MISSILE RANGE: Pres.—Maj. M. S. Arbogast, SigC., 217 Rossford Ave., White Sands Missile Range, N. M. Sec.—M. E. Brady, 4939 Blue Ridge Circle, El Paso, Texas.

REGION E

Regional Vice President—Walter H. Pagenkopf, Teletype Corp., 5555 Touhy Ave., Skokie, Ill. ***Michigan, Indiana, Illinois, Wisconsin, Minnesota, Iowa, Missouri, Kansas, Nebraska, North Dakota, South Dakota, Wyoming, Colorado.***

CHICAGO: Pres.—William L. McGuire, Automatic Electric Co., Box 35, Northlake, Ill. Sec. — Sanford Levey, 1303 Lincoln Ave. So., Highland Park, Ill.

DECATUR: Pres.—Capt. J. J. Lacey, 53 Whippoorwill Dr., Decatur, Ill. Sec.—E. R. Etter, 1675 E. Clay, Decatur, Ill.

GREATER DETROIT: Pres.—Col. J. I. Vanderhoof, 1921 Brock Court, Ann Arbor, Mich. Sec.—J. R. Saxton, Michigan Bell Telephone Co., 1109 Washington Blvd. Bldg., Detroit.

KANSAS CITY: Pres.—Lt. Col. G. D. Meserve, USAF(Ret.), 6211 West 55th St., Mission, Kansas. Sec.—R. P. Baker, Southwestern Bell Tel. Co., 6500 Troost, Kansas City, Missouri.

ROCKY MOUNTAIN: Pres. — Col. L. C. Heartz, 2301 Clarkson Dr., Colorado Springs, Colo. Sec.—Maj. H. W. Beaver, USAF (Ret.), 1936 Downing Dr., Colorado Springs.

SCOTT-ST. LOUIS: Pres.—Col. David W. Baugher, MOANG, No. 1 Grant Road, St. Louis 23, Mo. Sec.—Allan L. Eisenmayer, P.O. Box 456, Trenton,. Ill.

REGION F

Regional Vice President—Lt. Cdr. Ray E. E. Meyers, USN (Ret.), 717 Anderson Way, San Gabriel, Calif. ***Arizona, Utah, Nevada, California, Idaho, Oregon, Montana and Washington.***

ARIZONA: Pres.—Maj. C. D. Harding, 101A Henry Circle, Ft. Huachuca. Sec.—G. P. Walther, P. O. Box 4152, Huachuca City.

GREATER LOS ANGELES: Pres.—John W. Atwood, Hughes Aircraft Co., Culver City, Calif. Sec.—Joseph H. Goodrich, Pacific Tel. & Tel. Co., 737 S. Flower St., Los Angeles 17, Calif.

SACRAMENTO: Sec.—Capt. Robert McMorrow, 951 La Sierra Drive.

SAN DIEGO: Pres.—Capt. John H. Allen, USN, Navy Electronics Lab., San Diego 52, Cal. Sec.—Paul Vasquez, 9445 Doheny Rd., Santee, Calif.

SAN FRANCISCO: Pres.—H. L. Schnoor, Pacific Tel. & Tel. Co., 140 New Montgomery St., San Francisco 5, Cal. Sec.—H. W. Weddell, Rm. 117, Bldg. 35, Presidio of San Francisco, Calif.

SANTA BARBARA: Pres.—RAdm. Clarence C. Ray, 63 Manzanita Lane, Star Route, Santa Barbara, Cal. Sec.—Walter W. Montgomery, Raytheon Co., P.O. Box 636.

SEATTLE: Pres.—R. Pace, Pacific Tel. & Tel. Co., 1200 3rd Ave., Seattle 1, Wash. Sec.—W. E. Cruse, 4001 W. Concord St.

CHAPTERS AT LARGE

ALASKA: Pres.—Col. H. L. Hughes, USAF. Sec.—R. E. Witsiepe, Philco TechRep Div., Hqs., ACC, Box 6301, APO 942, Seattle, Wash.

FRANKFURT: Pres. — Ralph L. Prokop, USA Procurement Center, APO 757, N. Y.

HAWAII: Pres.—Col. W. A. Simpson, USA, Signal Office, Hq. USARPAC, APO 958, San Francisco, Calif. Sec.—Lt. Col. G. A. Kurkjian, USA (same address).

KOREAN: Sec.—William L. Wardell, OEC, RD-CD, APO 301, S. F.

LONDON: Pres.—Lt. Col. W. H. Fritz, MAAG-UK, Box 28, FPO, NY, NY. Sec.—Lt. Col. S. B. Hunt, CINCNELM Staff, Box 6, FPO, NY, NY.

MARIANAS: Pres.—Cmdr. C. J. Alley, USN, U. S. Naval Comm. Sta., Navy 926, FPO, San Francisco, Calif. Sec.—Lt. Cmdr. W. Scott, USN, P. O. Box, FPO, San Francisco, Calif.

OKINAWA: Pres.—Lt. Col. Russell Marks, 313th Air Division, APO 239, San Francisco, Calif. Sec.—Thomas G. Byrd, Jr., Hqs. U.S. Army Signal Group, RYIS APO 331, San Francisco.

PARIS: Pres.—Maj. Gen. Frank W. Moorman, Signal Div., SHAPE, APO 55, N. Y., N. Y. Sec.—Maj. John E. Mills, 7th Signal Battalion, SHAPE, APO 55, NY., N.Y.

PHILIPPINE: Pres.—Lt. Col. M. A. Vargas, USAFR, Hq. 13th Air Force, APO 74, San Francisco, Calif. Sec.—CWO-2 Robert L. Cloud, 1961st AACS Gp., Box 496, APO 74, San Francisco.

SAN JUAN: Pres.—Clyde Dickey, Porto Rico Telephone Co., P. O. Box 4275, San Juan, P. R. Sec.—Albert R. Crumley, Jr., Crumley Radio Corp., Box 10073, Caparra Heights, San Juan.

SWITZERLAND: Pres.—Capt. Gerald C. Gross, USNR, Intl. Telecommunications Union, Geneva. Sec.—Robert V. Lindsey, Intl. Telecommunications Union, Geneva.

TOKYO: Pres.—H. F. Van Zandt, Standard Electric Corp., Box 49, Shiba P.O., Tokyo, Japan. Sec.—P. W. Becker, Hq. U. S. Army Sig. Comm. Agency, APO 343, San Francisco, Calif.

Chapter News

REGION A

Fort Monmouth

The December 15 meeting was devoted to the traditional Christmas party and dance, held at the Sapphire Room, Gibbs Hall.

The January 19 meeting featured guest speaker Lieutenant Colonel George J. McNally from the White House Army Signal Agency. He spoke on "Presidential Communications," telling how the President of the United States is provided with communications when he goes on a global trip.

The chapter has announced plans for future meetings. February 16 Major General James B. Medaris, USA (Ret), author of the recently published book "Countdown for Decision," will be guest speaker. On March 16 Lieutenant General Arthur G. Trudeau, the Army's Chief of R&D will speak on "R&D: Gateway to Progress." April 20, Thomas Meloy, president of Melpar, Inc., will address the chapter on the subject of "Needs and Impacts of Basic Research." The May 18 meeting will be devoted to the traditional final dinner-dance and the election and installation of new officers.

Lexington-Concord

The second meeting of the chapter was held December 13 at the Carriage House, Lexington. James D. McLean, president of the Stromberg-Carlson Company was guest speaker.

Officers of the chapter are: president Lt. Col. Donald V. Mayer, USAF; executive vice president, Neal Breesman, Sylvania; vice president, membership, Forrest Ferguson, Raytheon; vice president, arrangements and programs, George Twigg III, Raytheon; vice president, education, Walter Baucom, Thompson Ramo-Wooldridge; treasurer, Lt. Col. I. H. Grayin, USAF; secretary, 1/Lt. James Burkley, USAF. Members of the board of directors are: Maj. Gen. Bergquist, USAF; J. Carter, Information Tech Labs Div. of ITEK; J. V. Holdam, Jr., Laboratory for Electronics; R. LaMontagne, Radio Corporation of America; Brig. Gen. McCollom, USAF; Maj. Gen. Mitchell, USAF; R. Osgood, Sylvania; J. Regan, Westinghouse; Maj. E. Schaad, USA; P. Schenk, MITRE Corp.; Dr. M. Schilling, Raytheon.

REGION B1

Philadelphia

A dinner-meeting and tour was held November 29 at RCA, Defense Electronic Products in Moorestown, N. J., with 175 members and guests attending. Preceding dinner there was a conducted tour through the Tracking Radar Test Facility. Following dinner, Henry W. Phillips, manager of Operations Administrations, Major Defense Systems, RCA, addressed the group.

"We are learning more about space and space problems at our test facility," he said. "And this gives us the criteria for developing data processing techniques compatible with the Space Age."

The signifiance of the tracking radar was pointed out by Mr. Phillips when he said that "in today's Space Age we are in a technological war in which the battle lines are in the laboratories and industrial plants of the United States and the Soviet Union. And in this day of 'technological miracles' a breakthrough development may occur at any time in a laboratory or in a test facility such as the one here in Moorestown."

Washington

A luncheon -meeting was held Decem-1 at the Willard Hotel Ballroom. Guest speaker was Dr. Hans K. Ziegler, chief scientist, U. S. Army Signal Research and Development Agency. He spoke on "The Army Signal Corps in Space: Past, Present, Future." Dr. Ziegler is president of the Fort Monmouth chapter.

Dr. Ziegler gave a summary of the Signal Corps work in space. He pointed out that SCORE, which carried the President's 1958 Christmas message, was the first communications satellite of any kind ever established.

In discussing the future, he said, "There seems to be little doubt that the Signal Corps' interest and role in space will continue to center around satellite communications and will be supplemented by basic mission interests in meteorology, surveillance and associated R&D aspects. ADVENT, as it shapes up now, will represent a highly sophisticated military communications system—but it can hardly be considered the ultimate goal. More capacity, more security, more reliability will be necessary—so there will be no doubt one or more "Advanced ADVENT" projects to follow, and the Signal Corps will most likely be a qualified and experienced Service to carry out also this phase of space work for our Nation."

REGION B2

Cincinnati

A dinner-meeting was held December 14 at the Cincinnati Club with 22 members and guests attending. Guest speaker was George H. Scheer, Jr., chief, Basic Techniques Branch, Avionics Division, Communications Laboratory, Wright-Patterson Air Force Base.

Mr. Scheer spoke on "New Horizons in Communications," a study of basic animal and human communications techniques and the possibility of adapting them to electronic means.

During the business meeting preceding the talk seven directors of the chapter were elected. Those elected are: J. L. Bowers, AVCO Corp.; John F. Jordan, Baldwin Piano Co.; N. A. Stegens, Radio Corporation of America; S. N. Suciu, General Electric Co.; Berz S. Wagner, Cincinnati & Suburban Bell Telephone Co.; Maj. Gen. Fred M. Warren, Chief of Reserve Affairs, D/A; H. A. White, American Telephone & Telegraph Co.

REGION C

Atlanta

Over 200 members of the chapter met November 29 for a dinner-meeting held at the Fort McPherson Officers Club. Guest speaker was Harold S. Black, research director for the Bell Telephone Laboratories. His subject was "Global Communications Via Artificial Earth Satellites." The talk was illustrated with slides taken during the preparation and launching stages of Echo I which was placed into orbit August 12, 1960.

At the conclusion of his talk, Mr. Black passed out similar pieces of "metallized mylar" material as comprise the "skin" of Echo I.

Augusta-Fort Gordon

A meeting was held December 15 at the Fort Gordon Officers Club. There were 83 members and guests attending. Following dinner and the installation of officers dance music was provided by Pfc. Sonny Curtis.

Special guests attending were Brigadier General B. H. Pochyla, ASTC commander and Colonel Robert R. Creighton, deputy commander, both members of the AFCEA national committee.

Gulf Coast

One hundred forty members, guests and wives attended the December 5 meeting at the Airmen's Club. The Bell Telephone Company provided the program which included two films, "The Big Bounce," concerning the Echo Project, and "Seconds for Survival," showing the communication system in the defense of our country.

The nominating committee presented the slate of officers for the new year.

REGION D

Tinker-Oklahoma City

The first dinner-meeting of the 1960-1961 year was held November 17 at the Tinker Air Force Base Officers Club. There were 67 members and guests attending.

Following dinner Bob Howard, chapter president, introduced new members. He also appointed a committee, to be headed by Robert E. Davis, to study a proposal made at the Executive Committee meeting held October 11. The committee will report on the best means the chapter can pursue to foster interest and encourage high school students of the Oklahoma City and Midwest City high schools to enter the scientific fields, primarily the electronics field. The chapter feels that early encouragement will help students to decide their fields of endeavor and to make preparations for entering these fields before they enter college.

Guest speaker was Commander William Laliberte, USN, presently chief, Liaison Branch, Plans Division, Bureau of Research and Development, Federal Aviation Agency, Washington, D. C.

Commander Laliberte gave a review of the FAA research and development program as involved in Air Traffic Control.

Using slides, Commander Laliberte showed present methods and projected methods now in development, which will not only enable safer air traffic control, but also have the capability for handling the increase in private operator traffic which is anticipated in the next ten years.

REGION E

Chicago

Space, survival, long-distance dialing and television networks were among the features of the December meeting.

The program was offered by the Illinois Bell Telephone Company, beginning with a tour of its Congress Street Toll Building, where members and guests saw first-hand how Direct Distance Dialing equipment works, and how television network arrangements are handled. Program arrangements were made by Walter H. Flinn, chapter vice president and general security manager of Illinois Bell.

The tour was followed by dinner and a guest speaker. Company president William V. Kahler made a welcoming address and then the film "Seconds for Survival" was shown. The film shows the nation's integrated defensive and retaliatory facilities.

Also serving with Mr. Kahler as host for the evening was Bowen H. Stair, operating vice president of Illinois Bell.

Speaker of the evening was Dr. John L. Glaser of the Bell Telephone Laboratories, who discussed the problems and prospects in world-wide communications using satellites.

Kansas City

A dinner meeting was held November 17 at Richards Gebaur Air Force Base Officers Club. The meeting was attended by 126 members and guests.

Guest speaker was William H. Massarand, government communications manager, Long Lines Department, American Telephone and Telegraph Company. Mr. Massarand's presentation was a taped speech, "The Complacent American—A Communist Weapon."

Scott-St. Louis

A dinner-meeting celebrating the Chapter's ninth anniversary was held December 2 at Augustine's Restaurant. Guest speaker Major General F. L. Ankenbrandt, USAF (Ret.), addressed 125 members and guests who attended.

Special head table guests included: General and Mrs. F. L. Ankenbrandt; General and Mrs. D. C. Doubleday, chapter director; Mr. and Mrs. Budd Reinhold; Colonel D. W. Baugher, chapter president; Walter H. Pagenkopf, AFCEA regional vice president; Mr. and Mrs. Allan L. "Pappy" Eisenmayer, chapter secretary.

Mr. Eisenmayer served as master of ceremonies for the meeting and program. He introduced guest speaker Major General F. L. Ankenbrandt, manager, Defense Electronic Products, Radio Corporation of America. General Ankenbrandt gave a brief history of Air Force communications, following the birth of AACS. He also gave a description of the organization and mission of the recently established Defense Communications Agency. In this connection, he outlined the contributions of the military services toward making DCA an unprecedented success.

Mr. Pagenkopf, vice president, manufacturing, Teletype Corporation, spoke on the present activities and future plans of AFCEA, both on a national scale and at the chapter level.

Guest speaker at the January 6 meeting was Captain H. K. Hyatt, USNR, vice president, engineering, Anheuser-Busch, Inc., St. Louis, Mo. Captain Hyatt first spoke to the chapter in February 1960 and returned at the request of many members.

CHAPTERS AT LARGE

London

The largest turnout of members and guests (110) in the history of the chapter met December 1 at the Columbia Club for a dinner meeting. Guest speaker was Brigadier General Kenneth F. Zitzman, USA (Ret.), who spoke on Project Ace High.

Among the many distinguished guests present were: Sir Reginald Payne- Gallwey, BT, Communications Consultant, associate vice president; Sir Harold Bishop, BBC, associate vice president; Major General Eric S. Cole, RA, Director of Telecommunications, The War Office, associate vice president; Major General Richard J. Moberly, Director of Communications and Electronics Equipment, The War Office; Brigadier General Richard B. Ridley-Martin, Chief Signal Officer, Eastern Command, Royal Army.

On January 26 members were the guests of the British Broadcasting Company. Following dinner the group toured the London Headquarters and new studios of the newly constructed ultra modern plant.

Marianas

The first all member "get acquainted" meeting of the chapter, hosted by the USAF, was held at the Rocker Club, Anderson AFB on November 17. Seventy-one members and guests were present.

Lt. Col. Wilmer E. Bullard, chapter president, introduced special guests Don King and Lee Warren of the Washington office of the Federal Aviation Agency, and Mr. Pearson of the Honolulu office of the FAA. He also recognized Don R. Auguston, Guam Electric Supply, Agana, and Charles R. Houser, Page Communications Engineers, Agana, as life members of AFCEA.

A tape recording of Major General Harold W. Grant's presentation of the Marianas chapter charter to Col. Bullard was rerun at the meeting.

A dinner and business meeting was held December 15 at the Breakers Club.

Okinawa

A luncheon and tour were held October 28 at the Harborview Club, Naha, Okinawa. Forty-five members and guests attended. The meeting was sponsored by Earl Datson, chief of communications, U. S. Civil Administration, Ryukyu Islands.

Members and guests toured the facilities of KSAR-TV, a Ryukyuan television station and the modern Naha Central Automatic Telephone Exchange.

Philippine

A dinner-meeting was held November 5 at the JUSMAG Officers Club. Thirty-one members and guests attended.

Special guests included Jack Friedman, RCA; C. C. Chapman, ITT; Colonel Cecilio C. Leoncio, Colonel Manuel B. Syquio; Colonel Armando V. Medel and Colonel Ceferino S. Carreon.

The speaker for the evening was Major John H. Judy, STARCOM, who gave a talk on the Pacific Scatter System and the role of the Philippine terminal in the system. Major Judy also gave a few highlights of the experiences in dealing with cobras, tin cans and carabao and their effect on the system.

Tokyo

A meeting was held November 25 at the Sanno Hotel. Armig G. Kandoian, vice president and general manager, International Telephone and Telegraph Corporation Laboratories, Nutley, N. J., spoke. He said that with the rapidly increasing volume of intercontinental communications, reliable and economic means to handle this traffic must be found.

He said that the use of active satellites in a high 24-hour orbit offers the most promising solution to this long-haul communication need. As proposed by ITT, the use of three such satellites in synchronous orbit 22,300 miles above the earth would permit communication instantly with virtually the whole globe.

Scott-St. Louis—(photo left) Shown at the ninth anniversary meeting December 2 are: (L to R) Walter H. Pagenkopf, AFCEA regional vice president, Teletype Corp.; Maj. Gen. F. L. Ankenbrandt, USAF (Ret.), RCA, guest speaker; Col. D. W. Baugher, chapter president; Maj. Gen. D. C. Doubleday, USAF, chapter director. (photo right) **London**—Guests at the December 1 meeting: (L to R) Brig. Gen. W. T. Howe, RA (Ret.); Sir Reginald Payne-Gallwey, BT, associate vice president; Brig. Gen. Kenneth F. Zitzman, USA (Ret.), guest speaker; Lt. Col. W. H. Fritz, USA, chapter president; Leslie Hinton, associate secretary.

New York—(photo left) RAdm. Ellery Stone at the speaker's rostrum delivering his talk on International Communications—Past and Future, at the November 30 meeting. (photo right) **Greater Los Angeles**—At the November 22 meeting: (L to R) C. E. McGuigan, director; John W. Atwood, president; Capt. W. G. Jackson, CO Office, Naval Research, Pasadena, Calif.; T. L. McKnight, director; Ray E. Meyers, first vice president, and regional vice president.

Cape Canaveral—(photo left) Pictured at the October meeting are: (L to R) speaker Dr. Ohm, Bell Telephone Laboratories; chapter president Lt. Col. J. W. Kelley, USAF; program chairman H. B. Hoeper, General Electric Co. (photo right) **Lexington-Concord**—Members of the board of directors with AFCEA national president Benjamin H. Oliver, Jr. Pictured are (L to R, front row) R. LaMontagne, Mr. Oliver, Maj. Gen. C. H. Mitchell, USAF, Maj. E. Schaad, USA, (back row) W. Frailey, P. Schenk, Col. D. Higgins, USAF, M. Schilling.

Washington—Pictured at the December 1 meeting are : (L to R) Maj. Gen. R. T. Nelson, USA, Chief Signal Officer; Dr. Hans K. Ziegler, U. S. Army Signal Research and Development Laboratories; Brig. Gen. J. C. Monahan, Chief Research and Development Division, Signal Corps. (photo right) **South Texas**—(L to R) Steve H. Simpson, program chairman, Jack Ammann, guest speaker, and Col. Hugh Moreland, chapter president. Mr. Ammann, president of Jack Ammann Photogrammetric Engineers, spoke at the December meeting held at Kelly AFB Officers Club.

Augusta-Ft. Gordon—New officers of the chapter (L to R) George Norman, treasurer; Lt. Col. Hamilton T. Crowell, secretary, Col. Thomas J. Trainor, president; Maj. George A. Dewey, 2nd vice president and J. W. Owen, 1st vice president. (photo right) **Chicago**—Dr. John L. Glaser of Bell Telephone Laboratories discusses the problems and prospects of world-wide communications using satellites at the December meeting.

Association News

Note of Appreciation

National Headquarters wishes to extend its thanks to the many members, company executives, group and sustaining members, advertisers and advertising agents, plus countless other friends who sent Christmas greetings and wishes for the New Year.

New Group Member

Laboratory for Electronics, Inc., has joined the Association as a group member. Main offices are located in Boston, Mass. Company representative is George H. Levine, manager, Public Information Office.

Others named to membership are J. Vance Holdam, Jr., vice president; Robert C. Kelner, director, Computer Products Division; George F. George, N. E. regional sales manager; Albert E. Keleher, director, Marketing Division; John E. Stacy, product manager, Navigation Systems; Eugene S. Rehrig, product manager, Air Traffic Control; William P. Maughan, regional manager, Dayton, Ohio; Nelson S. Praigg, western regional manager, Los Angeles, Calif.; J. G. Prout, manager, Marketing Administration; E. M. Allen, sales engineer, Air Traffic Control.

U. S. Military History Collection

An article recently published in the *Birmingham News Magazine* tells of a collection of military history of the U. S. and Dwight D. Eisenhower. The collection is the hobby of Michael F. Barno and is housed in a specially prepared room in the library of Oklahoma Military Academy at Claremore, Oklahoma. Mr. Barno is an alumnus of the Academy.

The Eisenhower collection is believed to be the largest in the world. According to Mr. Barno his purpose in building up the collection of military history is "to perpetuate our military heritage —to tell the story of the American Armed Forces, the bulwark of democracy; to promote greater interest in and appreciation of the freedom of education, freedom of enterprise, as well as other freedoms which are strong links in the American way of life."

Mr. Barno is a member of the Montgomery chapter.

RCA Becomes Sustaining Member

Radio Corporation of America has become a sustaining member of the Association. It formerly was a group member.

Civilian and military officials are shown above during a recent cruise aboard the U. S. Second Fleet flagship *USS Northampton* for briefi and demonstrations of naval communications. *Northampton* left the Norfolk Naval Base on December 1 and returned the following day. D onstrations included communications between the *Northampton* at sea and military installations around the world.

The officials are seated (from left to right): Maj. Gen. H. W. Grant, USAF; Mr. J. M. Bridges; Maj. Gen. James Dreyfus, USA; Maj. G E. E. Cook, USA; RAdm. Frank Virden, USN; Capt. T. F. Caldwell, USN. (Standing left to right) Mr. John Golden; RAdm. W. D. Irvin, U Adm. M. W. Curts, USN (Ret.); Mr. R. L. Clark; Mr. J. L. Westrate; Lt. Gen. W. P. Ennis, USA; Mr. J. H. Lewis; BGen B. A. Hochm USMC; Cdr. Richardson Phelps, USN; Col. R. Fuller, USMC; VAdm. H. T. Deutermann, USN, Commander Second Fleet; Capt. J. S. R USN; Mr. Philip Le Boutillier, Jr.; Capt. C. R. Norris, USN; and Col. C. J. Lester, USAF.

First lady member of the London chapter, Capt. V. E. Shannon, WRAC, is welcomed by (L to R) Lt. Col. Sanford B. Hunt, USMC, Lt. Col. Fritz, Brig. Gen. Zitzman and Maj. Gen. Richard J. Moberly. Capt. Shannon attended the December 1 meeting held at the Columbia Officers Club.

Millard C. Richmond, (center) manager of government relation Western Electric Company, receives the Army's Certificate Appreciation from Assistant Secretary of the Army Courtney Johnso in a Pentagon ceremony January 3. Mrs. Richmond is at righ (See story on page 59.)

Those named to membership by the company are: M. R. Amsler, manager, Marketing Dept., Surface Communications Div.; Gen. F. L. Ankenbrandt, manager, Defense Product Assurance; Gen. W. G. Bain, vice president and general manager, Communications and Aerospace; C. E. Burnett, division vice president, Industrial Tube Products Dept.; P. H. Clark, manager, Dayton Office; S. W. Cochran, division vice president and general manager, Surface Communications Div.; A. N. Curtiss, general manager, West Coast Missile & Surface Radar Div.; C. R. Denny, vice president, Product Planning & Marketing; Dr. E. W. Engstrom, senior executive vice president; Dr. D. H. Ewing, vice president, Research and Engineering; J. B. Farese, division vice president, Entertainment Tube Products Dept.; F. M. Farwell, vice president, Marketing; J. L. Frederick, manager, Marketing Dept.; Missile and Surface Radar Div.; F. H. Gedicks, administrator, Market Development, Astro-Electronics Div.; Dr. A. M. Glover, vice president and general manager, RCA Semiconductor & Materials Div.; F. E. Green, manager, Marketing Dept., Airborne Systems Div.; C. A. Gunther, chief defense engineer; I. K. Kessler, division vice president and general manager, Airborne Systems Div.; W. B. Kirkpatrick, general manager, Missile Electronics & Controls Div.; J. W. Kirschner, manager, Washington Office, Electron Tube Div.; B. Kreuzer, division vice president and general manager, Astro-Electronics Div.; R. S. LaMontagne, manager, Marketing Dept., Missile Electronics & Controls Div.; A. L. Malcarney, executive vice president, Defense Electronic Products; W. H. Painter, division vice president, Operations Planning, Semi-conductor & Materials Div.; J. H. Sidebottom, ministrator, Marketing Staff, Defe Electronic Products; D. Y. Smith, v president and general manager, El tron Tube Div.; E. E. Spitzer, manag Power Tube Operations, Electron Tu Div.; M. G. Staton, manager, Mar Development, Astro-Electronics Div.; Sternberg, chief engineer, Astro-El tronics Div.; R. A. Teare, manag Contract Negotiations & Administrati Astro-Electronics Div.; W. W. W group executive vice president; H. Wege, vice president and general m ager, Missile & Surface Radar; R. Wick, manager, Industrial Sales, Se conductor & Materials Div.; S. N. L division vice president and general m ager, Moorestown Missile & Surf Radar Div.; H. I. Miller, vice preside Product Development, Defense El tronic Products.

Millard Richmond Honored

Millard Richmond was presented the following Certificate of Appreciation on January 3, for his contributions to national defense. The award was presented by Courtney Johnson, Assistant Secretary of the Army.

The Department of the Army
Certificate of appreciation for
Patriotic Civilian Service
Is Awarded To
Mr. Millard C. Richmond

Mr. Richmond has made an outstanding contribution for Army logistics by promoting a better understanding between the military and industry during the period 1954 to 1961. He has served in numerous high offices of organizations related to national defense. During the period 1956-1957 he was President of the Washington Chapter of the Armed Forces Communications and Electronics Association. During the period 1959-1960 and for 1960-1961 he has held successively the offices of Vice President and President of the Washington Post of the American Ordnance Association. He currently is Vice President of the George Washington Chapter of the Association of the United States Army and Treasurer of the National Security Industrial Association of Washington.

Motivated by a deep sense of patriotism, Mr. Richmond has assisted materially in keeping the public informed of the missions and aims of the Army. His unselfish service is in keeping with the finest traditions of public service and reflects great credit upon himself and American industry.

San Juan Chapter Aids the Deaf

The San Juan Chapter recently received 50 British-made hearing aid mechanisms from member Jack Schwartz of International Standard Electric. The members started a work project to activate the aids by building battery power packs. Committeeman Paul Steves and Homero Cordero presented the hearing apparatus to the St. Gabriel School for the Deaf.

The committee tested the first two completed hearing aids at St. Gabriel's on December 14 with the help of the Mother Superior. In a group of fifteen girls tested all but one was able to understand messages spoken into the aid. None of these girls had ever heard a word spoken anywhere but in the sound room, but with the aid of these new gadgets they will be able to hear anywhere.

Alaska Joins Association as 56th Chapter

Alaska became the 56th chapter in the Association following approval of its charter on January 20. Officers of the chapter were elected at the initial organizational meeting. Those elected are: president. Col. H. L. Hughes, USAF; 1st vice president, Col. C. A. Thorpe, USAF; 2nd vice president, Col. E. C. Humphres, USAF; secretary, R. E. Witsiepe, Philco Corp.; treasurer, 1/Lt. A. O. Bliss, USAF.

The following committees were appointed by the president: membership, Col. C. A. Thorpe; constitution, Col. E. C. Humphres; programs, F. D. Chiei, Jr., RCA; publicity, 1/Lt. A. B. Salisbury, USA, SigC.

NEW MEMBERS

Listed below are new members of the AFCEA who have joined the Association during the month of December. Members are listed under the chapter with which they are affiliated. Amateur radio operators are listed with their call letters.

Arizona
Capt. William C. Clements
Williard I. Johnson
Lynnon J. Knight
Arthur J. Leclair, Jr.
James F. Logau
Lt. Col. Mark T. Muller
Lt. Col. Wilmer B. Stevens
Howard C. Storck

Atlanta
William L. Adams
P. G. Chandler, Jr.
Sallie S. Crawford
Clinton H. Johnson
D. G. McGinnis
Alvin H. Merkl
J. M. Parker
William Leonard Pickard
Tom G. Townley
William C. Tumlin
William H. Worrell, Jr.

Augusta-Fort Gordon
Ken M. Belcher
2nd Lt. Norman H. Childs
Raymond L. Gleason
Samuel B. Merritt
Lawrence Russell

Baltimore
LCDR. Leister F. Graffis
Mrs. John A. Shipley
Morris Tischler

Boston
Edward G. Dehart
Richard P. Dwyer
Albert Linsky
Malcolm C. McGrath
Col. Wayne L. O'Hern
Dominick V. Rosato
G. Arthur Smith

Chicago
Floyd Basler
Kenneth W. Jarvis
Dr. Ernest A. Keller
Ringland M. Krueger
Walter C. Rokosz
Robert J. Siedare
Anthony C. Smith
Lt. Col. John P. Spickelmier

Cincinnati
N. Carter Hammond
Freas Edwin Semmer
Richard P. Weyand

Dayton-Wright
Harry C. Blackburn, W8MFX
Maj. David G. Clute
Charles Colbert
Allen H. Janssen
Dale W. Martin
William P. Maughan
Earl J. Schreiber
Col. B. J. Smith
James A. Wood

Decatur
Wilbur H. Davis
Donald L. Falk
Robert C. Jones
John C. Thomas

Fort Monmouth
Bernard G. Beck
Mrs. Winifred S. Ellis
Dr. D. H. Ewing
Clarence L. Francis
Lt. Col. William G. Gaughan
Stanley Grubman
Arthur R. Kaney
William J. Laverick
Matthew Lyon
Robert McKinley, Jr.
2nd Lt. Heth P. Percival
Lt. Col. George M. Snead, Jr.
George W. Snedaker

Frankfurt
CWO Joseph H. Demico
Capt. Harvey S. Manis
Capt. Roy E. Shelby

Greater Detroit
Ken M. Kiel
C. D. Tillery

Greater Los Angeles
Charles E. Appling
A. N. Curtiss
J. Ray Donahue
Lt. Col. Francis Duggan
Nelson J. Favreau
Simon A. Golbert
Arthur L. Hansen
Evert C. Hokanson
Bernard H. Linden
Nelson S. Praigg
Gerald C. Stack
Harold Frank Wienberg

Gulf Coast
Jack Cox
Capt. John D. Curran
CM-SGT. Gayland W. Dill
CWO, W-2 Maurice B. Grim
Paul B. Johnson
Capt. James R. McFeeters
James R. Morris
T-SGT. M. T. Morrison, K4QWB
Miss Mary H. Porter
Capt. Ervin F. Rees
Robert F. Sandall
Lt. Col. Leonard J. Schaitel
Charles E. Thompson
Donald Gene Weber

Hawaii
Louis Augustine
Lambert C. Chock
Francis C. Dixon
B. Lee Gaber
Minoru Harada
James M. K. Stone
Mrs. Della E. Pennington
John T. Pennington
Lt. Col. Jim Russell
Charles K. Suzuki

Kansas City
R. Fred Fairly
William B. Foulis, Jr.
Elwyn L. Gear
Harold B. Jacobs
George E. Miller
Charles C. Minx
William J. Riley

Lexington-Concord

E. M. Allen
A. James Baillie, K8EEE
Maj. Francis E. Bannan
Lee Blankenship
Pauline U. Collins
Sidney Cornell
Howard T. Cullum
SQD. Leader Melvin J. Cummings
Richard F. Daly
William A. Detlefsen
Lawrence Drew
Elbert L. Eaton
Pete Evanko
Charles H. Fetzer
Harold Fienman
Maj. Roland J. Fitzgerald
James J. Fitzpatrick, Jr.
Stephen M. Friedrich
Frank L. Fuller
George T. Galt
Joseph S. Gaziano
1st. Lt. Louis B. Gennaro
George F. George
Benny B. Hall
Richard A. Heath
James G. Hendrick
J. Vance Holdam, Jr.
Capt. Billy J. Jackson
Ira W. Kane
Albert E. Keleher
Robert C. Kelner
Capt. E. Hugh Kinaey
W. B. Kirkpatrick
Simon Kleiner
John L. Knight, WIVMG
R. S. Lamontagne
Ralph H. Lent
Leo McDonnell
Larry G. Monroe
Leonard Paris
John A. Polutchko, Jr.
J. G. Prout
Eugene S. Rehrig
John F. Reilly
Col. Daniel E. Riley
Martin J. Rottenberg
Maj. Edwin M. Schaad
Ronald V. Sharpe
Joe Sherman
Col. Nicholas A. Sisak
Capt. Jesse W. Smoot, Jr.
John E. Stacy
Robert D. Stumpf
David C. Sullivan
Karl D. Swartzel
Maj. Victor K. Syphers
William E. Thresher
George S. Thomas
Capt. James O. Varner
Harry A. Webb
William E. Wendt
Robert L. Winder, K1PMY
M-Sgt. Harold M. Wright

Lexington

James Phillips, Jr.

London

Frank H. Taylor

Louisiana

Samuel A. Carleton
Elmo S. Koschel

Marianas

Harry M. Engel

Bernard E. Gerken
Andrew J. Murray
K. M. Pier, KG6AFO
CTI, K. M. Schurr, WA6DMY

Montgomery

Lt. John K. Aho

New York

Stuart E. Crosby
Austin G. Cooley
Charles R. Denny
Jasper Desando
A. Dumont
Dr. E. W. Engstrom
J. B. Farese
Edwin H. Gehricke
A. Gera
Dr. A. M. Glover
James L. Mackernan
Sal L. Messina
Taylor Moore
Leopold P. Oberst
T. R. O'Hara
William J. Ormston
W. H. Painter
Robert E. Pincus
Bernard Schectman
Elliott Schlam
John Walter Shanahan
D. Y. Smith
George Paul St. Lawrence
Capt. Benjamin R. Surovy
Eric O. Tiderman
Paul M. Trueger
Henry Von Wiegandt
R. D. Wick

North Carolina

D. A. Ashford
Richard B. Cashwell
Maj. Donald W. Martz

Northeastern University

Charles Joseph Bianco
David F. Connelly
William W. Crowninshield
Joseph S. Fagone, Jr.
Albert James Finkel
Thomas Warren Gagnon
Robert James Gallagher
Richard F. Garvin
Ronald Henry Gerlach
David W. Porta
David S. Powell
Robert M. Zaruba

North Texas

H. L. Housley
David E. Parker

Northwest Florida

Robert E. Cilley
H. R. Hall
Lt. Roy C. Leggitt
CWO Lawrence E. Magart
Capt. William E. Shine
Lt. Col. Harry W. Webster
Capt. William O. White

Orange

Robert G. Schild, W4CAI

Paris

William J. Dobberstein

Edmond G. Doppler
Col. James E. Dupree
Gabriel La Tour
Jean Andre Roy
Guy J. J. Roy
J. C. Simon

Philadelphia

M. R. Amsler
C. E. Burnett
Albert George Cattell
J. L. Frederick
H. Hecht
I. K. Kessler
S. N. Lev
Mort A. Maurer
Harry Polish
Herbert C. Roth
Arthur L. Rowland
F. L. Rudisill
Lawrence J. Russ
Hugh A. Saul
Richard F. Smith, Sr.
E. E. Spitzer
Russell J. Turner

Philippine

CWO George D. Swan

Pittsburgh

Stanley W. Doran
Thomas G. Shannon

Rocky Mountain

Capt. Edmond J. Borkowski
Ervin J. Kofler
Geraldine A. McNeilley
James Robert Miller
Group Capt. Robert E. Mooney
James L. Sims

Rome Utica

Zygmund J. Bara
W. Raymond Burrows
John T. Killip
John J. King
William F. Sailor
Harold L. Wilson

San Diego

Robert J. Parry

San Francisco

Donald C. Bennion
Raymond K. McClintock
Maj. William D. McHenry
Alfred O. Rasmussen

San Juan

Hector S. Nicolau
Alberto F. Soto

Santa Barbara

Col. Nicolaus Gaynos, WIKQR, WA6OYG
A. R. Lamb

Scott-St. Louis

Maj. James R. Bean
Maj. Maurice J. Boots
Earl E. Cupp
Maj. James W. Grubbs
Earl E. Jones
William L. King
Robert M. Totty
Harry A. Turner

Seattle

Joe Erak

South Texas

Dennis M. Kniery
Charles F. Martin, W5C
Henry C. Turner
S. J. Zantek

Syracuse

Frederick J. Aspinall
Morse E. Galliett
Marvin T. Glenn
Richard McMahon
A. Noel Reagan
Richard D. Sims

Tinker-Oklahoma Ci

Edward W. Cawthon
Leslie P. Laing
Edward W. Petersen
Col. Giles H. Gere

Tokyo

Francis S. Butash
CTCA Salvador Cervero
John W. Hamilton
CTI Harold J. Melphrey
Maj. Marshall E. Neal
LCDR. Donald B. Wenge
ACO Jessie R. Wisdom
Hajime Yoshida

Washington

CDR. Newell A. Atwood
Harold P. Belcher
Lt. Col. Robert W. Canny
Everett A. Corey
Gen. G. H. Decker
Conan J. Doyle
Maj. Melvin R. Erickson
Donald E. Hall
W. D. Joslin
Joseph A. Kersey
J. W. Kirschner
Alberto Li Gobbi
Walter M. Mendus
H. I. Miller
James M. Perry
Donald R. Phillips, W3
Robert W. Reilly
H. G. Shaffer
David C. Sherrick
LCDR. Leroy J. Sindell
Robert F. Smith
Roger W. Stoner
Justin R. Sypher, Jr.

Members At Large

Oscar W. Akerstrom
SM-SGT Douglas Jon Bo
Lt. Col. Eddie J. Carmic
William L. Coker
Lt. Col. Loren E. Guyer
Graziano Graziani
Ir. Pieter Harkema
John L. Hart, III
William E. Holmes
Capt. John H. Keller, Jr.
Ernest O. Kuenzig
Joseph O. Kuenzig
T-Sgt. Harold G. Menzies
Willis M. Patterson
Col. Luther J. Ross
T-Sgt. Charles W. Staggs
Maj. Stephen V. Tingley,
Leonard C. Whitsitt

Plug-in reliability with ALTEC professional audio equipment

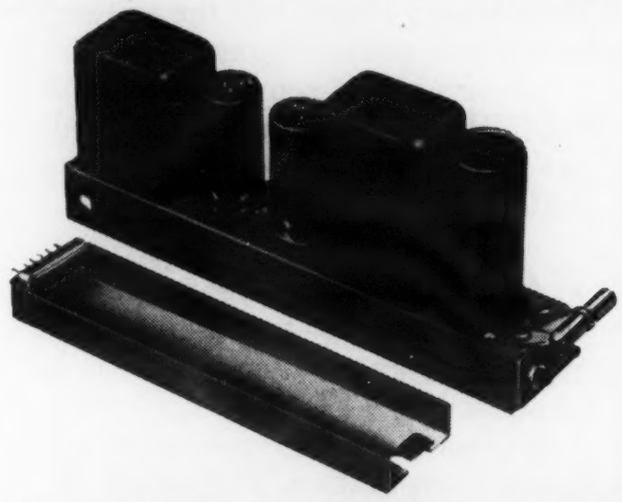
250 SU CONSOLE Combining compact simplicity with maximum flexibility through Altec advanced design, the new 250 SU Altec has proven to be the ultimate in control consoles for TV, AM, FM, recording studio or sound system use. Newly designed miniature plug-in preamplifiers, and utility input devices of uniform size and interchangeability permit free range in number and type of amplifiers used per console.

Characterized by single unit construction for simplicity (amplifiers and controls within same housing) and economical installation, Altec's 250 SU features an externally mounted power supply for cool operation and isolation of strong magnetic fields.

Providing complete circuitry for all stereo or universal operating functions, there is no finer, more reliable control console serving the audio industry. Individual components are available complete with plug-in trays for custom and rack installation.

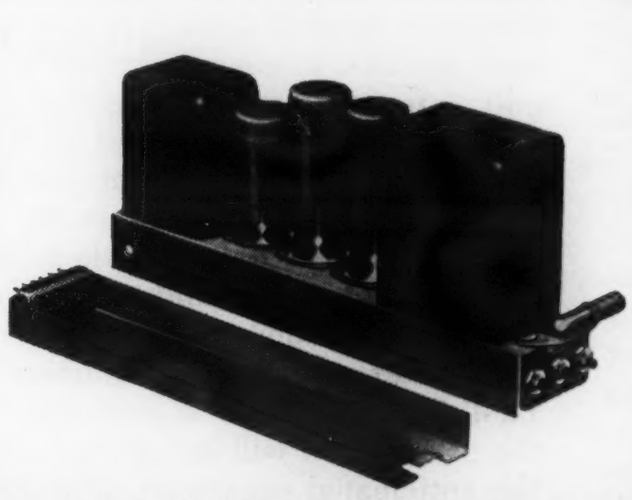
THE 250 SU FEATURES:

- Meets NAB, EIA, and recording requirements
- "Plug-in" units completely interchangeable
- Low impedance mixing
- Speech-music filter
- D.C. heater supply
- Utility input devices for tape-disc-line-networks, etc.
- Tube testing provisions
- Expandable to jack fields, equalizers, etc.
- Up to 10 mixing channels
- Single channel operation
- Two channel operation
- Two channel/three channel operation
- "Stereo" operation
- Illuminated meters
- Color coded controls
- 16 connected inputs
- Microphone level or "high level" on any input



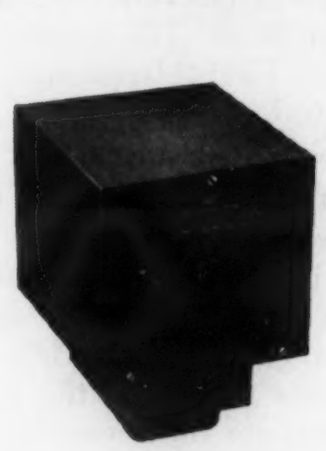
458A "PLUG-IN" PREAMPLIFIER An extemely simple, highly reliable, low noise preamplifier, the 458A incorporates a single stage push-pull cross-neutralized vacuum tube circuit, transformer coupled to source and load. Maximum reliability with unfailing performance are achieved through simplified design featuring fewer components, extremely accurate balance of input and output transformers, and premium quality pre-aged, shielded tubes. The failure of either tube will not cause loss of program.

SPECIFICATIONS GAIN: 40db unterminated input, 34 db terminated. **POWER OUTPUT:** +20 dbm at less than .5% THD 50 to 15,000 cps. +25 dbm at less than 1% THD at 1 KC. **FREQUENCY RESPONSE:** ± 1 db 20 to 20,000 cps. **SOURCE IMPEDANCE:** 150 or 600 ohms (centertap for 600 ohms). **LOAD IMPEDANCE:** 150 to 600 ohms (centertap for 600 ohms). **OUTPUT IMPEDANCE:** Equal to load impedance. **NOISE LEVEL:** Equivalent input noise: −126 dbm. **POWER SUPPLY:** 15ma at 275vdc and .7a at 6.3vdc. **TUBES:** 2−6072/12AY7. **DIMENSIONS:** 1 3/4" W x 3 15/16" H and 9 11/16" L. **COLOR:** Cad plate, dichromate dip. **WEIGHT:** 3 1/2 lbs. (including tray). **SPECIAL FEATURES:** Push buttons for individual tube test. 40ma dc can be applied to center taps for simplexing. **ACCESSORIES:** 13225 Rack Mounting Assembly (for 9 units). 13401 Mounting Tray Assembly. 5981 Tube Test Meter. 535A Power Supply.



459A "PLUG-IN" PROGRAM AMPLIFIER A highly reliable, low noise program amplifier with exceptionally large power capability, the 459A consists of a 2-stage push-pull circuit with a balanced negative feedback loop. Push-pull operation of all stages provides reliability, interchangeability with preamplifiers for added gain and power. Superior overall performance results from special input and output transformer design of ultrafine balance combined with premium quality pre-aged shielded tubes. Program transmission is not interrupted by failure of either output tube.

SPECIFICATIONS GAIN: 56 db unterminated input, 50 db terminated. **POWER OUTPUT:** +30 dbm at less than .5% THD 30 to 20,000 cps. +35 dbm at less than 1% THD at 1 KC. **FREQUENCY RESPONSE:** ±1 db. 20 to 20,000 cps. **SOURCE IMPEDANCE:** 150 or 600 ohms (centertap for 600 ohms). **LOAD IMPEDANCE:** 150 or 600 ohms (centertap for 600 ohms). **NOISE LEVEL:** Equivalent input noise: −126 dbm. **POWER SUPPLY:** 40ma at 275 vdc and 1.6a at 6.3vdc. **TUBES:** 1−6072/12AY7, 2−12BH7. **DIMENSIONS:** 1 ¾" W x 3 15/16" H x 9 11/16" L. **COLOR:** Cad plate, dichromate dip. **WEIGHT:** 3 1/2 lbs. (including tray). **SPECIAL FEATURES:** Push buttons for individual tube test. 40ma dc can be applied to center taps for simplexing. **ACCESSORIES:** 13225 Rack Mounting Assembly (for 9 units). 13401 Mounting Tray Assembly. 5981 Tube Test Meter. 535A Power Supply.



535A POWER SUPPLY Compact, highly reliable, the 535A is the DC power supply for furnishing the operating voltages to the Altec 458A and 459A amplifiers used together with the Altec 250 SU Console. Externally mounted to preclude hum, the 535A employs silicon rectifiers in both the filament and "B" supplies. The 535A connects to the 250 SU by means of a 4-foot multiple conductor cable terminated in a type P306CCT Jones plug which "mates" with a Jones receptacle in the 250 SU Console. A single screw frees the power supply unit from its mounting bracket for inspection.

SPECIFICATIONS POWER OUTPUT: 275vdc at 275ma. At 275ma ripple is .02v peak to peak max. 6.3vdc at 13a. At 13a evc ripple is 1.5v peak to peak max. **POWER INPUT:** 117v 50-60 cps 245 watts at full load. **RECTIFIERS:** Silicon. **CONTROLS:** 1. Power Switch. 2. Circuit Breaker (Push to reset). 3. 4 Position tap switch (provides adjustment of voltage by autoformer action to accommodate 2 to 1 range of loads). **COLOR:** Dark Green. **WEIGHT:** 16 pounds. **SIZE AND MOUNTING:** 7 3/16" W x 9 5/8" H x 7" D overall.

ALTEC LANSING CORPORATION

A subsidiary of Ling-Temco Electronics, Inc.

1515 Manchester, Anaheim, Calif. • 161 Sixth Avenue, New York 13, N.Y

ALTEC LANSING CORPORATION

For FREE technical literature on ALTEC Professional Audio Equipment, write Dept. S-2-M

©1960 Altec Lansing Corporation

NEWS ITEMS AND NEW PRODUCTS

Dr. Harold S. Osborne of Upper Montclair, N. J., retired Chief Engineer of the American Telephone and Telegraph Company, has won the Edison Medal of the American Institute of Electrical Engineers. The award was presented at the AIEE Winter General Meeting held in New York, January 29 through February 3, 1961.

Dr. Osborne, who is a consultant with the International Electrotechnical Committee, was cited "for his contributions to the art of telecommunication and his leadership and vision in extending its application; for his achievements in the coordination of international communication and in national and international standardization; and for his advancement of the engineering profession."

• • •

The Federal Aviation Agency has announced its acceptance of a semi-automatic system to check VOR, TACAN and VORTAC air navigation facilities. The system, Semi Automatic Flight Inspection, or SAFI. was designed by the Airborne Instruments Laboratory for FAA.

Until the advent of SAFI, the method used to flight check navigation facilities was time consuming and expensive. An aircraft flew circles around each facility while comparing reference points on the ground with readings on the receivers in the aircraft. These measurements were repeated three times a year for both transmitters in each facility. This method is further complicated when bad weather is present or high altitude tests are attempted, since flying with reference to the ground is difficult if not impossible. In addition, this method requires coordination with the facility by voice, thereby inconveniencing maintenance personnel.

FAA has equipped five Convairs with SAFI equipment. These aircraft will fly a straight line grid pattern across the United States, directed by magnetic tapes prerecorded on an IBM 704 computer located in Oklahoma City. The equipment will detect gross errors in received bearings so that immediate corrective action may be taken. Magnetic tape records of signals actually received will be made in digital form for later analysis on the IBM 704 to obtain an exact record of the performance of each station.

The prerecorded tape contains route information, to navigate the aircraft on a straight line path, and tuning information for each receiver. When a facility comes within range of the aircraft, a receiver is automatically tuned to the proper frequency. Receiver output is changed from analog to digital form for recording on the output tape. Some of the receivers are used to navigate the aircraft while others are checked, under control of the input tape.

The problem of keeping the tape synchronized with the location of the aircraft has been neatly handled. The expected location contained in the tape is compared with the digital output of the receivers being used for navigation. When the readings agree, the tape is advanced and the process is begun again. The tape is advanced several times each second and permits a course deviation of only a few tenths of a mile.

There are eight hundred stations in the U.S. that will be checked initially by the SAFI equipment. By 1965 it is expected that there will be around twelve hundred stations. The SAFI equipment in each aircraft may be expanded as the number of facilities increase. It is expected that the five aircraft will be able to handle the anticipated expansion until 1975.

• • •

Successful fabrication of a cryogenic thin film memory plane the size of a postage stamp and the development of automatic control techniques capable of duplicating it many times has been announced by the International Business Machines Corporation.

The memory plane, consisting of 135-cryotron devices built up in 19 layers of material, was fabricated by scientists at IBM's Federal Systems Division Laboratory in Kingston, N.Y., working in conjunction with IBM Research.

In this device, three cryotrons form a memory cell which combines storage with an elementary logic operation. The equipment used for deposition of microscopically thin layers of metals and insulating terial on glass substrate, allows layer to be sequentially depo through 17 microscopically adj masks, or perforated metal s The masks are changed automat and are held in a large metal cyl operating under high vacuum. the masks have been properly ali the process automatically pro duplicate superconducting me planes with similar electrical mechanical characteristics.

Forty separate pieces or "bit information are stored in 120 trons in the new memory plan the remaining 15 cryotrons, 10 mit access to the stored bits o formation; the other five are line" cryotrons which switch bi information from one memory to another. The newer "in-line" trons operate faster than conve al cryotrons in communicating tween the memory planes. They permit faster communication bet the memory planes and the arith portion of the computer. Resear in progress to refine the thi fabrication techniques to pr cryogenic devices of even gr speeds.

• • •

A new ultra high frequency d with capabilities for increasing range of microwave systems has produced by ITT Federal Divisi International Telephone and graph Corporation, Clifton, N.

Known as a "paramp," or par tric amplifier-converter, the makes it possible for an operat turn up the volume of a received signal without increasing static other interference noise. When ployed in a typical troposph scatter over-the-horizon system, paramp can be used either to inc range or reduce power. For inst it can stretch a link operating o kilowatts of power from its lim 250 miles to more than 350 miles —conversely, reduce power req ments from 10 kilowatts with no in range.

Heart of the system is a diff junction silicon parametric diode veloped at ITT Laboratories, subminiature workhorse has b applications in low-noise ampli and other systems where high cu

TS

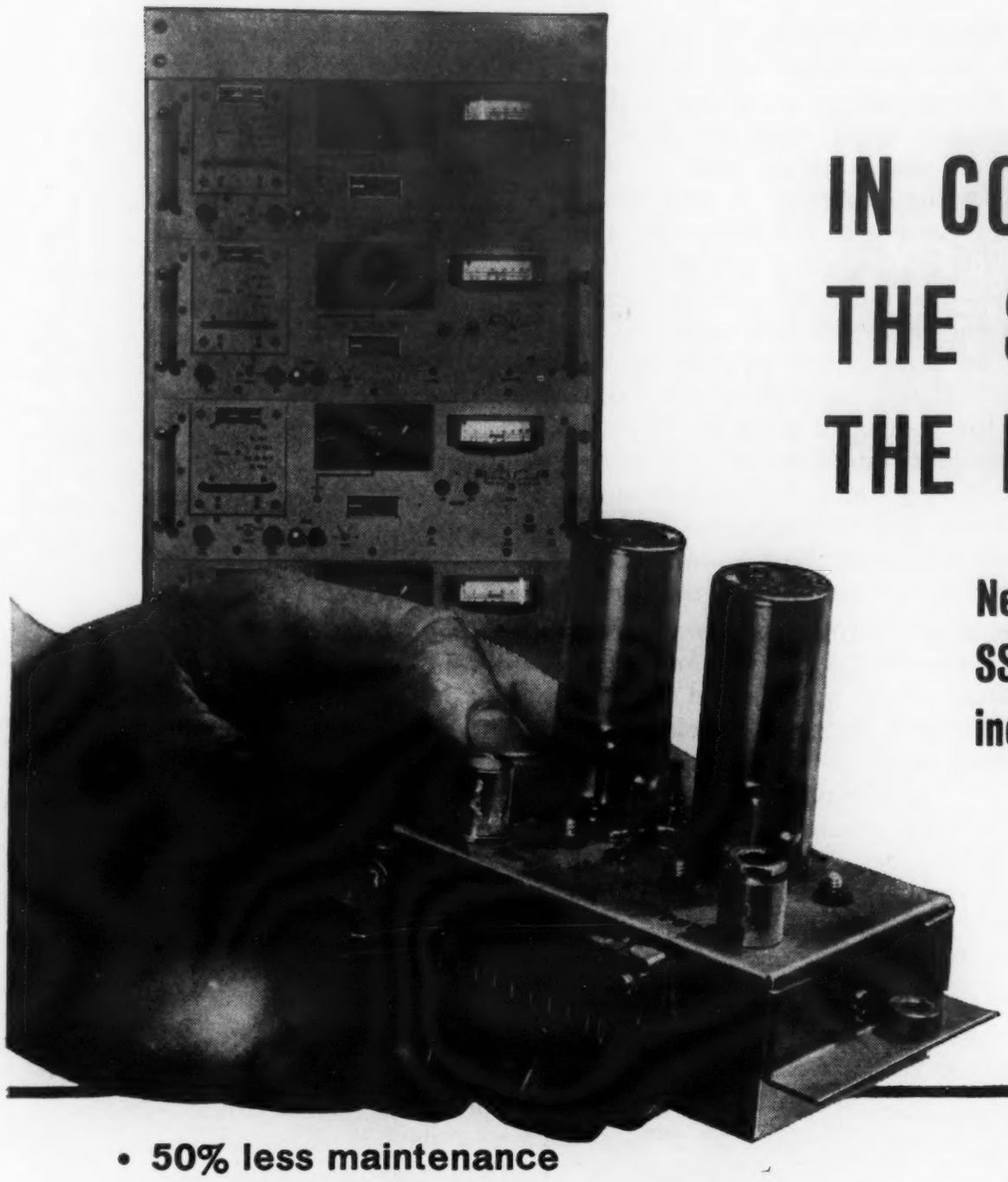
sulating ma-
allows each
y deposited
lly adjusted
etal sheets.
utomatically
etal cylinder
cuum. Once
erly aligned,
y produces
g memory
ctrical and

r "bits" of
120 cryo-
plane. Of
ns, 10 per-
bits of in-
e are "in-
tch bits of
mory plane
line" cryo-
convention-
icating be-
They also
on between
arithmetic
esearch is
thin-film
produce
n greater

ncy device
asing the
has been
ivision of
and Tele-
N. J.
parame-
he unit
erator to
ved UHF
tatic and
hen em-
spheric
tem, the
increase
instance,
g on 10
limit of
iles—or
require-
no loss

diffused
ode. De-
es, this
broad
nplifiers
cut-off

RY, 1961



IN COMMUNICATIONS... THE SIMPLER THE BETTER

New Hallicrafters all-modular SSB strip receiver cuts costs, increases reliability.

- **50% less maintenance**
- **Far greater stability and reliability**
- **Down time almost entirely eliminated**
- **Lower initial cost**

Hallicrafters' new SX-116 SSB Receiver is the essence of simplicity—key to reliability in the Hallicrafters Series 116 communication system.

The SX-116 is entirely modular in construction, *virtually eliminating "down time" and cutting maintenance cost by over 50%.* The unit is quickly and easily adaptable to existing systems, entirely compatible with future requirements.

It is extremely stable—1 part in 10^6 per month (standard) or 1 part in 10^8 per month (special) . . . it permits, for the first time, continuous, unattended operation with *maximum reliability.*

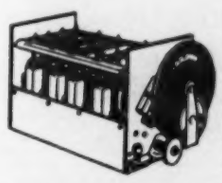
The SX-116 weighs in at just 36 lbs.—equally practical for fixed, mobile, air or seaborne installations. *And its initial cost is very substantially lower.*

Finding a better and simpler solution to complex communications problems has been a Hallicrafters habit for over a quarter-century.

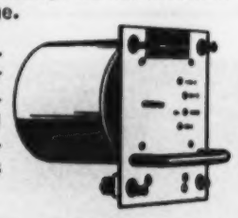
hallicrafters

Military Electronics Division, Chicago 24, Illinois

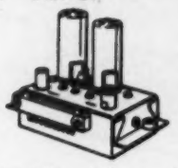
100% modular construction—only seven basic components



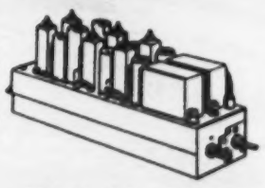
RF Module. Image and IF rejection maintained at better than 70 db. Single tuned circuit between antenna and RF grid. Four-channel, continuous tuning—2.0 mc. to 30 mc. range.



HF Crystal Oscillator Module. Stability: 1 in 10^8 per month. Capacity is four crystals; designed for HC-6/U metal or glass crystal holders. Oven temp. varies less than ±0.01°C.

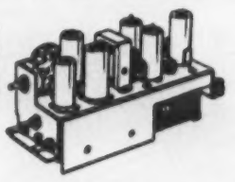


Injection Amplifier Module. AGC-controlled wide-band video amplifier provides constant injection level.

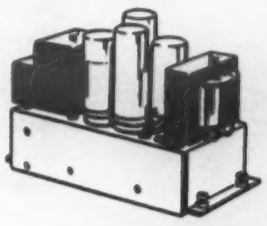


IF Module. Allows simultaneous reception of upper and lower sideband, independent AGC control of upper and lower sideband.

BFO Module. Operates at 1650.000 kc. Oscillator frequency stabilized in separate oven. Plate and filament voltages regulated.



Audio Amplifier Module. Features duel, independent 100-milliwatt line amplifiers. Hum level is 80 db. below 100 milliwatts. Harmonic dist. less than 0.5%.



Power Supply Module. Separate transformers provided for regulated and non-regulated voltages. Local oscillator and BFO filament supply are regulated for ±10% line voltage variations!

Write for complete specifications on the SX-116.

HALLICRAFTERS REGIONAL SALES ENGINEERS

William E. Peugh—Joseph A. Small
4401 W. 5th Avenue, Chicago 24, Ill.
VAn buren 6-6300

Thomas H Pretorius
7558 S.E. 15th St.,
Oklahoma City, Okla.
PErshing 7-2456

Earl L. Giffin
Box 568, Far Hills Br.,
Dayton 9, O.
AXminster 8-5230

Merle J. Long
513 E. Manchester Blvd.,
Suite 201,
Inglewood 1, Calif.
ORchard 3-6661

H. Kenneth Hudson
626 Lakeview Dr., Falls Church, Va.
CLearbrook 6-4978

James R. Spencer
Box 435, Lincroft, N.J.
SHadyside 7-2309
(Red Bank, N.J.)

LOOKING FOR A CHALLENGING OPPORTUNITY? We have openings for communications systems and equipment design engineers at all levels. Please write to William F. Frankart, Director of Engineering.

frequency is required. The parametric amplifier-converter is used mainly in the UHF band between 300 and 3000 megacyles. It derives its name from the fact that amplification takes place through the controlled variation of one of the circuit parameters. Because the device does not rely upon a metered flow of electrons for amplification purposes, it eliminates the noises generated by conventional amplifiers and results in an over-all receiver noice figure between 1.5 and 2.0 db. Use of the ITT Federal system therefore provides a 6 to 10 db. increase in sensitivity over standard receivers for the reception of weak signals.

• • •

"The Committee for Inventions and Discoveries, USSR Council of Ministers, on November 15, 1960 issued a diploma to Candidate of Technical Sciences N. I. Kabanov for a discovery the Soviets named 'Kabanov's effect.' The discovery is related to the phenomenon of returning radio waves, upon reflection by the ionosphere and by the earth, to the point of their origin over distances of 'many thousands of kilometers.' It is noted that in similar experiments performed in other countries, non-Soviet scientists have offered explanations which 'have denied the possibility of reflection from the surface of a planet.' Kabanov refuted these opinions after a series of observations and exreriments. The practical implications of his discovery are seen in the possibility of 'selecting optimum frequencies for long-range communications, for investigation and observation of ionospheric conditions, for increasing the reliability of radio links, for making it possible to work with simpler antennas and less transmitter power, and for significantly decreasing radio interference.' It is the first time that the Committee has awarded a diploma for a discovery."

The above information was taken from *Current Review of the Soviet Technical Press* distributed by the Business and Defense Services Administration, Office of Technical Services, U. S. Department of Commerce. The original Soviet article is listed as *Izvestiya,* 16 Nov., 1960, I. Tsyganov; *Komsomol'skaya pravda,* 16 Nov., 1960.

• • •

A portable survey meter capable of detecting extremely low levels of radiation, particularly designed for use around radar and microwave installations and x-ray laboratories, ha been developed by The Victoreen In strument Co., Cleveland, Ohio.

The Victoreen 440 will detect an measure radiation of less than 1 mi liroentgen an hour by picking u currents generated as the radiatio enters an air ionization chambe through a very thin mylar window It covers an energy range of 6.5 ke to 1.2 mev and its read-out dial ca be set for one of five sensitivit ranges which encompass from zero t 300 milliroentgens per hour (kev i 1,000 electron volts and mev i 1,000,000 electron volts).

• • •

Radio Corporation of America ha developed a tiny solid-state electroni device called a "varactor" diode.

According to RCA the new diod is one of seven types announced b the Company that operate within frequency range from 2,000 to 20 000 megacycles. They are sensitive to the degree of picking up an amplifying microwave signals trans mitted at frequencies close to thos of infrared light.

Called "varactor" diodes becaus they act as variable capacitors whe operating in electronic circuits, th new devices are smaller and lighte than standard buckshot. When op erating in an electronic circuit varac tor diodes take a microwave signa coming in from the atmosphere o outer space and kick it to a highe energy level by phasing in a "pump" signal generated by another source within the circuit. The original signal is thus amplified and can then pass on through several additional stages of amplification until it is sufficiently strong to activate equipment such as a speaker, radar scope or computer.

• • •

General Communication Company, Boston, Massachusetts, has announced a new design concept for coaxial switches. The new mechanical approach has resulted in a new line of medium-power coaxial switches and is the result of the design and development of medium-power switching gear for Polaris-Firing Fleet Ballistic Missile submarines. Two, three, four and six position models are available with a glass-sealed header. This switch meets the requirements of MIL-E16400B.

Frequency and power range are 6KW CW at 30 megacycles, 3KW CW at 100 megacycles, and 500 W CW at 1,000 megacycles. The maximum RV voltage is 1,000 volts. Crosstalk is greater than 60 db up to 1,000

(*Continued on page* 66)

RELIABILITY...
As research and development surge ahead, reliability becomes an absolute necessity. To this end we are dedicated to serve you in the fields of precision metal fabrication and electronic assembly to your specifications, one piece or a hundred.
Send for Facilities Brochure
Mech-Tronics Corporation
Manufacturers of Aircraft and Missile Components
1635 N. 25th Avenue, Melrose Park, Illinois • phone FI 4-9823
Southwest Division, Phoenix, Arizona

Want to **write** a phone call?

...just add *Electrowriter*®

Electrowriter® instruments give you the accuracy of the written message at the speed of the telephone voice. You write (or sketch) on the Electrowriter instrument as you would with an ordinary ball pen and paper. Your longhand message is transmitted by telephone facilities any distance and instantaneously recorded in your own handwriting by the remote Electrowriter receiver. Any number of Electrowriter stations may also be connected through private leased wires . . . or any telephone quality pair of wires.

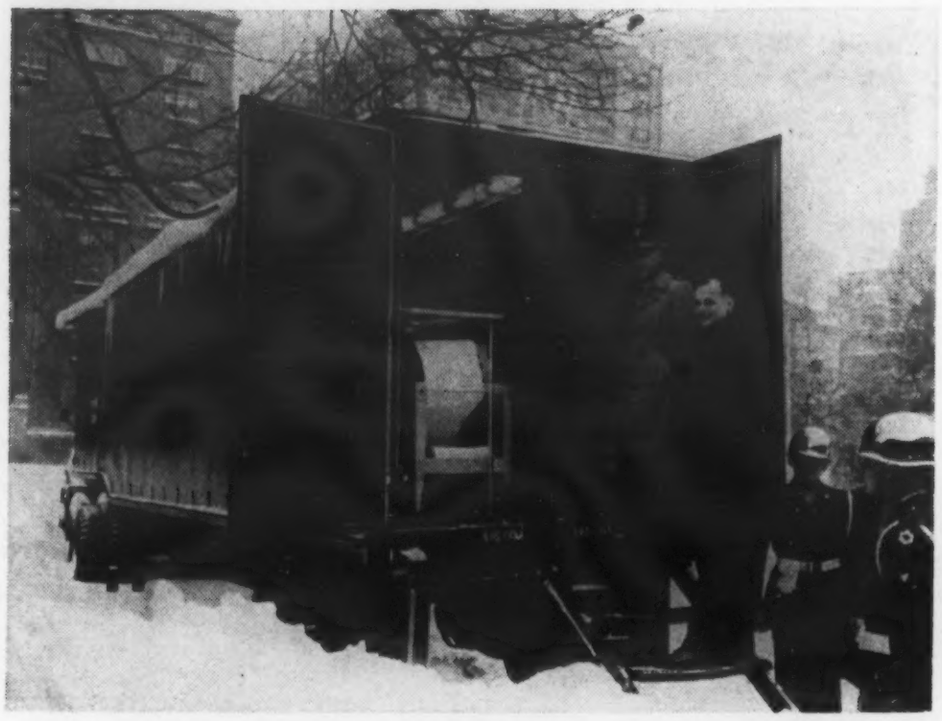
Electrowriter instruments are accepted for use over local and long distance facilities of the Bell System, General Telephone System and other telephone companies.

®ELECTROWRITER
TRADEMARK REGISTERED,
U. S. PATENT OFFICE

For demonstration, call or write:

COMPTOMETER
CORPORATION

5600 Jarvis Avenue • Chicago 48, Illinois • SPring 5-2400 • Offices in Principal Cities



Shown at the first public demonstration of MOBIDIC (Mobile Digital Computer for battlefield use) are Brig. Gen. John C. Monahan, Chief, U. S. Army Signal Corps' R & D Div., and Henry Lehne of Sylvania. The demonstration took place in NYC's Central Park last December. MOBIDIC was developed and produced by Sylvania for the Army. The first operational model is in use by the 7th U. S. Army Stock Control Center in Western Germany.

megacycles. The voltage standing wave ratio is 1.1 to 1 maximum up to 100 MC and 1.15 to 1 maximum up to 1,000 MC. RF connectors are the HN type. RF circuit is up to six positions. Operating voltage is 115 volts DC ± 10%. Current is 1.25 ampere surge during switching. Operation is remote controlled.

• • •

The Multi-Channel Voice Recorder is a 22 channel magnetic tape recorder which has been designed and developed by Webcor Inc., of Chicago, for the Federal Aviation Agency, Washington, D. C. for use in all airport traffic control centers in the U. S. Its function is to record on magnetic tape, all data from the many sources within the area, including information from airplanes, towers, land lines and other communication areas. In some of the larger areas, as many as 8 of these 22 channel recorders are required and can be used simultaneously.

Model 104-1 is automatic in operation and is capable of operating unattended, continuously for 32 hours. The equipment is rack mounted and consists of two identical tape transports each providing 16 hours of recording time on all 22 channels, with automatic transfer from one reel to the other. Each reel holds 4800 feet of magnetic tape. Normal recording and playback tape speeds are 15/16 inches per second, with fast foreward and reverse speeds at 250 inches per second.

• • •

A new emergency communication system for motorists stranded on highways has been produced by Hoffman Electronics Corporation of Los Angeles. The system consists of a central receiving site and stategically placed highway call stations, small box-shaped units which can be mounted on lamp poles or posts alongside highways at any convenient location.

Each electronic satellite station is independently powered by batteries, recharged by solor cells similar to those used in space satellites, and needs no external wires or power. The unit's nickel-cadmium battery pack allows operation during extended periods without sunlight by storing energy for 150 transmissions by the self-contained FM radio transmitter. Each transmitter has an output of one watt, which gives reliable communications under all weather conditions over a line of sight distance of 18 miles.

The emergency signals showing location and type of service needed are sent to a central receiving station which dispatches the proper vehicle from the nearest point to the emergency. A motorist can summon emergency service by pressing one or more of the four buttons marked "Ambulance," "Fire," "Police," or "Service truck." The call system is flexible, providing for incorporation of additional buttons for broader utility. Call units and receiving sites can be located wherever required.

Radiation Service Company, a subsidiary of Radiation Incorporated, Melbourne, Florida, has been appointed East Coast distributor to sell, install and service the highway call system, by Hoffman Electronics Corporation.

• • •

Westinghouse Electric Corporation is developing a new communications system called Ultracom which uses ultraviolet light for transmitting signals in outer space. In experiments at the company's air arm division, television picture signals have been carried by an ultraviolet beam. The extremely short wavelengt the ultraviolet beam is respons for a greater range and other ad tages of Ultracom. The new c munications system will be free f interference or static because short wavelength of the beam penetrate the atomic particles space barriers such as the Van A radiation belt. Information carr on the Ultraviolet beam will be most impossible to detect and int cept. The new system would not p mit direct contact between a spa vehicle and receiving stations on earth, but would require the use orbiting "relay" satellites to retra mit the information at longer wa lengths.

Westinghouse engineers produ ultraviolet light for the experiment system by means of a phosphor luminescence tube. A beam of el trons within this tube is directed a phosphor-coated screen recently veloped by the company's electron tube division, Elmira, N.Y.

• • •

Hughes Aircraft Company's micr wave tube division is producing t new x-band high gain traveling wa amplifiers capable of 10 to 100 tim the average power of convention helix tubes.

The power increase is achieved use of folded waveguide structures replace the helix and special period focusing techniques. The Hugh 307H has a 100 kw peak power ou put (500 watt average) with a min mum of 50 kw over an 8.5-95 k frequency range. It has 54 db sat ration gain and operates with a 38 beam voltage. Maximum duty cyc is one percent. The 307H is eng neered of metal and ceramic mat rials, with all-heliarc welded gun an window assemblies, long-life di penser-type cathodes, and integrall designed ion pumps. Its total weigh including periodic magnets is 2 pounds.

The grid-controlled 308H tube ha a 15kw peak power output (150 wa average), and 8.6-9.9 kmc frequenc range; and a 53 db saturation gai Control grid μ is 55. Maximum dut cycle is one percent and beam voltag 24 kv. The electron beam can b modulated on and off with a voltag pulse of less than 500 volts applied t the low-capacitance grid. Pulse ris times of the order of 10 to 50 mil microseconds can be achieved wit the tube. The grid-controlled 308H is metal-ceramic structure with in tegral periodic permanent focusin magnets. Its total weight is 1 pounds.

A vertical motor generator that eliminates shaft deflection and therefore vibration has been developed by Leach Corporation of Compton, California. The magnetic forces on the rotor produce a slight lifting action in the vertical direction and thus take most of the load off the thrust bearings.

The new unit, also available for defense or industrial laboratory uses, is an addition to the Leach brushless synchronous line and will handle ratings from 125 KW to 175 KW.

• • •

Otarion Listener Corporation, Ossining, N.Y., has developed an eyeglass-frame hearing aid which allows the wearer to distinguish the voice of the person facing him from among a babble of voices.

A tiny microphone is implanted in the bridge of a pair of eyeglass frames. The "up-front" position of the invisible microphone brings in the person directly in front more clearly than surrounding conversations and noise. The front microphone picks up the wanted voice and carries the sound into full-range hearing aids built into either or both eyeglass-frame side pieces.

• • •

Utilizing the toll message network of long-distance telephone lines in conjunction with the Bell System Data-Phone 100, a new model Teledata 8-channel code transmitter-receiver is being offered by Friden, Inc. of San Leandro, California, as a means of communicating business data and other messages between branches, plants, and the home office. The company believes this facility will result in savings to those whose volume of data traffic does not warrant the use of a fulltime circuit, such as the intermittent transmission of orders from branch sales offices. The customer pays only for the time the lines are actually in use.

Speeds of 425 codes per minute are obtained and a parity checking feature insures that transmitted codes are accurately perpetuated for accomplishing subsequent data processing functions efficiently.

Message tapes are punched on such data processing machines as the Friden Flexowriter, then taken to the Teledata/Data-Phone transmitting center where they are fed through the Teledata reader component. By either dialing directly or calling the operator, a contact is made with the

For that IRE ®

NEW IDEA

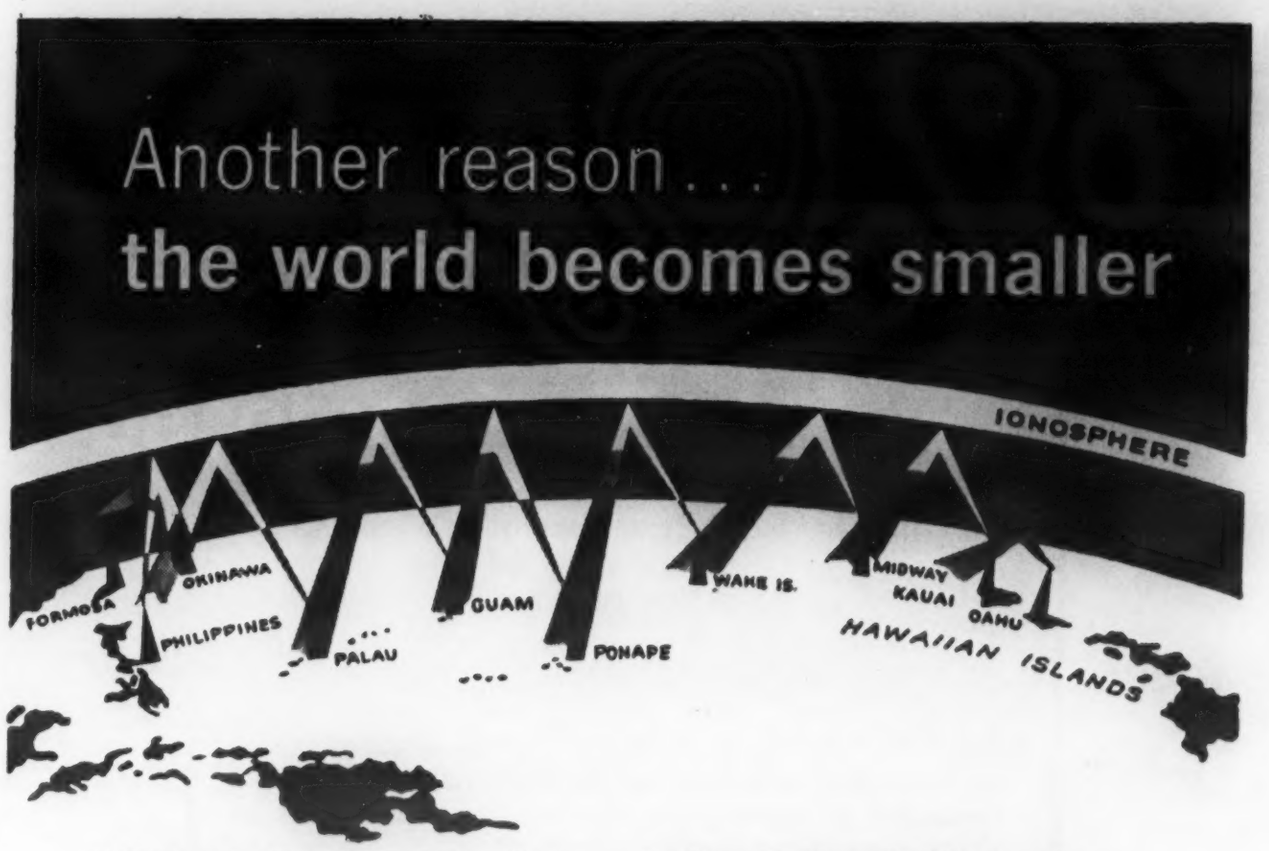
visit the

IRE SHOW

March 20-23, 1961 New York

Coliseum and Waldorf-Astoria Hotel

Members $1.00, Non-members $3.00 Age limit—over 18



7,500-mile Pacific Scatter Communication System linking major command posts from Hawaii to Formosa was recently designed and built for the U. S. Army Signal Corps

by

Page COMMUNICATIONS ENGINEERS, INC.

Subsidiary of Northrop Corporation

2001 WISCONSIN AVENUE, N.W.. WASHINGTON 7, D.C.

desired receiving station. Both parties then touch a button on respective subsets which connects each to the telephone line. Transmision then begins. At the receiving end, a Teledata unit accepts the coded data and punches it into 8-channel tape. This tape may then be used to reproduce messages, orders and other business documents on a Flexowriter or on any tape-operated equipment for which it is intended.

The same rates apply as those currently effective for long-distance calls. Data-Phone lease rates vary depending on the government tariff in the particular area of installation. Teledata units may be either leased or purchased.

• • •

Introduction of a small, 118 lb. air conditioner designed specifically for weapon support equipment has been announced by Task Corporation, Anaheim, California.

The new unit occupies less than four cubic feet, making it ideally suited for cooling air-transportable electronic equipment. Rotating elements operate in the industrial speed zone of 3400 to 3700 RPM for both compressor and fans. The unit is offerred in 60 and 400 cps models. Both models contain the same basic parts. Specifications at MIL spec rated capacity include operation to 125° F ambient air, 600 CFM conditioned air flow, and 5.4 KW power consumption under peak operating conditions. Dimensions are 24¾ x 17¾ x 14¾ inches.

• • •

The Sylvania 9400 is a general-purpose digital computer developed to serve as the nucleus of large-scale, custom-designed data processing systems. Sylvania describes the 9400 as the most powerful computer in production for engineering and scientific applications and general administrative data processing. It will be marketed solely to federal agencies and operating telephone companies.

Completely transistorized, the 9400 is a multiple-computer system, incorporating a central information processor and satellite data input-output processors. It is capable of performing four separate tasks on a continuing basis at the same time its primary function is being carried out at the rate of 125,000 operations per second. The 9400 is capable of direct operation through voice circuits, teletype lines and microwave communications networks, and also may be utilized with special digital disp and control equipment.

Sylvania 9400's presently be produced include those scheduled installation at the Data Systems erations in Needham, Massachuse and at the General Telephone Co pany of California in Santa Moni The Needham installation is sch uled for completion this month a the Santa Monica installation in S tember.

• • •

A transistorized Photoelectric Co troller is a new product of the Sy cuse Electronics Corporation, Sy cuse, N.Y. The PE-601 consists o transistor amplifier and a power su ply packaged in a plug-in unit me uring 2x2x1½ inches. The lig source and the cell are contained a 2x1¼x½ inches aluminum ho ing.

The system operates from 1 VAC 50/60 cycles with power co sumption of less than 3 watts tot Sensing range is from portions of inch to eight feet. Integral sensitivi adjustment provides for a wide ran of applications from detecting gla diodes to the detection of transl scent sheets of paper and linen.

Counting rate is up to 2000 coun per minute. Output relay is 2 PD 5 Amps contact rating. The unit ca be light operated or dark operate

• • •

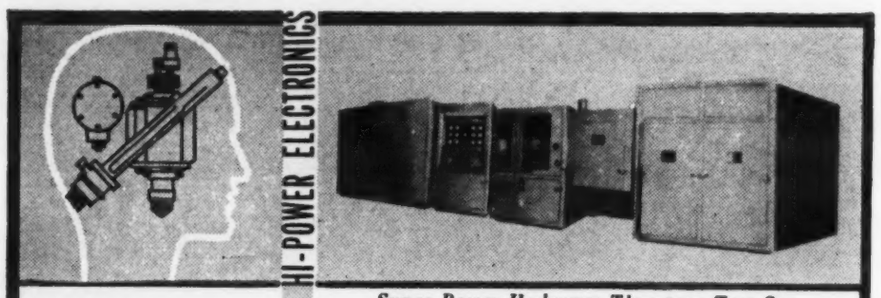
Cannon Electric Company, Los A geles, has developed a series of min ature solenoids for industry use.

The solenoids have been designe to meet all requirements of MIL-S 4040C and are manufactured wit diameters of ¼, 5/16, and ½ inch voltages of 6, 12, 24, 36, 115 an 230 VDC and power ratings of ½ watt and up. They may be used fo applications in digital computer printers, punched tape block reader automatic calculators, code ha switches, highspeed printers, inte grated data processing equipmen tape readers, telemetry equipmen electronic counters, X-Y plotters, log gers, digital modules and other elec tro-mechanical systems.

• • •

Technical details of Ramo-Woold ridge's "stored logic" machine wer provided at the Eastern Joint Com puter Conference held in New Yor last December.

The new computer, being produce by Ramo-Wooldridge for the Navy under the designation AN/UYK-1



Super Power Hydrogen Thyratron Test Set

Dynamic solutions with creative ingenuity

FXR's high power electronics has produced the Super-Power Hydrogen Thyratron Test Set used as the tool for the development of super-power modulator tubes.

FXR's top-rated position in High Power Electronics can be credited to extensive, specialized facilities. But most important in serving you are the creative abilities of FXR's engineering staff.

Perhaps a modulator problem similar to your own has already been solved by our technical group. An experienced FXR applications engineer is just a phone call away.

FXR, Inc.

Design • Development • Manufacture

25-26 50th STREET • RA. 1-9000
WOODSIDE 77, N. Y. • TWX: NY 43745

will be delivered to the Navy Bureau of Ships about the middle of this year. Seven other stored logic computers have also been ordered by Thompson Ramo Wooldridge Inc. for use by corporate divisions.

Stored logic, in the Ramo-Wooldridge concept, permits the user to select a word length, order structure and instruction repertoire especially suited to the problem at hand. These normally wired-in characteristics are specified by data stored in the computer's memory and may be changed during the normal loading procedure without hardware modification. The wide range of applications which the AN/UYK-1 can handle include such tasks as radar data processing, trajectory computation, navigation, fire control, system checkout, inventory control, preventive maintenance, pattern determination, range safety, personnel record processing system simulation, servo loop control and data reduction and processing.

The AN/UYK-1 has relatively few components because it is organized as a parallel 15-bit word element machine. While 15-bit arithmetic is suitable for some jobs aboard naval vessels, many problems require longer words. By manipulation of its 15-bit word elements, the machine can be made to operate in a wide variety of modes: using word lengths of 15, 30, 45, and so on, bits as either a fixed point or floating point machine; using any number of index registers of indirect addresses; as a character data processor; or using any combination of these features.

The term "stored logic" has been used to describe this computer because the sequences required to perform instructions are stored in the core memory. A typical set of lograms will take up less than 10 percent of the memory.

• • •

Autonetics of Downey, California, displayed its new Recomp III solid state digital computer at the Eastern Joint Computer Conference. The new machine has a 4096-word magnetic disk memory with each word having 40 bits. The computer can reportedly handle more than 8000 instructions. It uses a simplified command list of 32 standard commands plus five compacted floating point commands. Standard input and output is 10 characters per second by Flexowriter or paper tape punch.

Use of the optional Facitape input/output equipment increases inputs to the computer to a rate of 600 characters per second and output to 150 characters per second.

In addition, Recomp III provides four input and output plugs where additional optional equipment such as card readers, magnetic tape, line printers, and analog-to-digital converters can be used thus further extending the computer's capabilities.

Main memory access time is 9.3 milli-seconds and using the two high speed loops this time can be reduced to 1.75 milliseconds. Operation time for fixed point computations is 0.54 milliseconds for add-subtract functions; 10.8 milli-seconds for multiplication and 11.1 milli-seconds for division. Using the optional floating point, add-subtract time is 1.1 milliseconds; multiplication, 12.4 milliseconds and division, 12.7 milliseconds.

Recomp III operates from any standard 115 volt, 50-60 cps, ac power source. Total computer size, including desk , is 30x30x60 inches. Weight is 250 pounds.

• • •

Production by Minneapolis-Honeywell Regulator Company of a new electro-chemical system for controlling corrosion is scheduled for the first quarter of 1961, the company's Rubicon Division has announced.

Called Anotrol, the system will be offered initially for control of corrosion in sulfuric acid storage. The system is said to make stainless and mild steel containers resistant to such corrosive chemicals as sulfuric, phosphoric and nitric acids and a variety of strong caustics by electrically depositing and maintaining a protective film on metal surfaces.

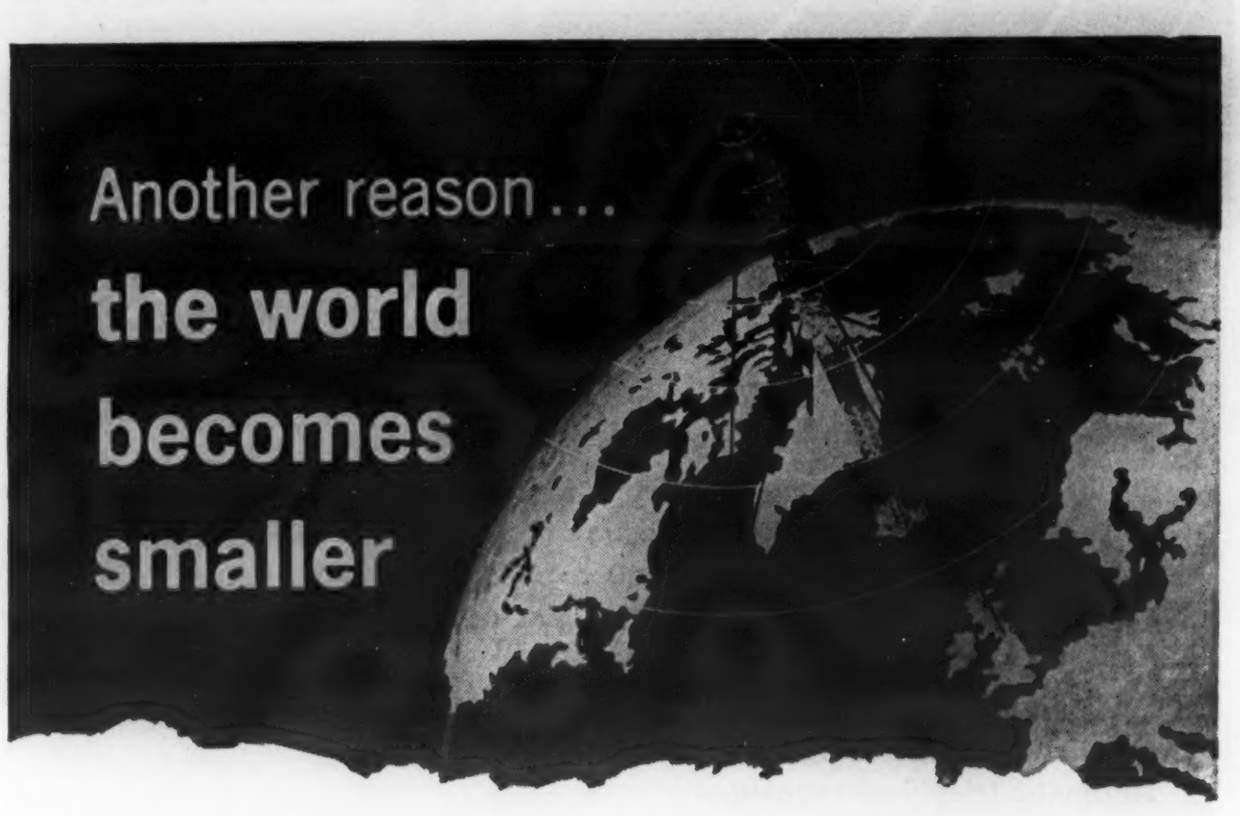
• • •

A new 3-channel instrumentation quality magnetic tape recorder, measuring 2 x 4 x 5 inches and weighing 31 ounces (including 7 ounces of tape), has been introduced by Precision Instrument Company, San Carlos, California.

Designed for direct recording of dynamic data in the range from 100 to 5000 cycles, the new recorder is capable of operating in any environment where man can exist.

The Model PS-303M can be used in conjunction with standard IRIG telemetry sub-carrier oscillator equipment for multiplexing up to 30 channels of data in the range from dc to approximately 100 cps.

The recorder requires ¾ watt of power, supplied by standard mercury cells or other low-impedance power sources, and will record a minimum



A new Voice of America broadcasting facility in Liberia is being engineered by Page. Three previous VOA stations in Tangier, Okinawa, and the Philippines, bringing together over 100 nations, were designed and built by

Page COMMUNICATIONS ENGINEERS, INC.

Subsidiary of Northrop Corporation

2001 WISCONSIN AVENUE, N.W., WASHINGTON 7, D.C.

AE has had a hand in the development of many specialized communications control systems for the armed forces.

For instance, dial-controlled intercommunication network for the U. S. Navy that permits the automatic selection of any one of 45 radio channels from as many as 60 remote points aboard ship. Communications can be restricted to conference circuits or trunked to the ship's public address system.

Switching of this type is a logical extension of AE's 70 years of experience in the design of intricate circuit-routing systems for automatic telephone exchanges.

If you have a tough project in communications or control, AE can assist in the design, and supply you with basic components or complete control packages.

For more information on our special capabilities, write or phone (FIllmore 5-7111) the Manager, Government Service Division, Automatic Electric Sales Corporation, Northlake, Illinois.

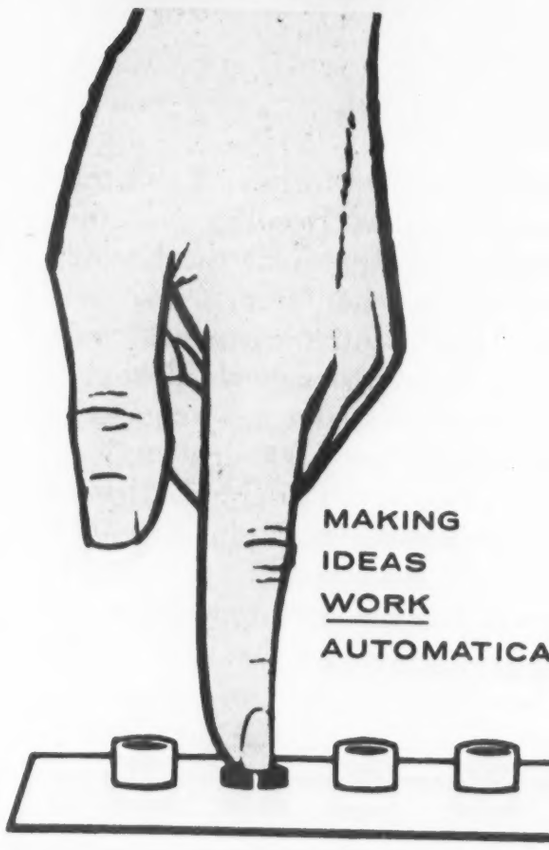
AUTOMATIC ELECTRIC

Subsidiary of

GENERAL TELEPHONE & ELECTRONICS

GENERAL SYSTEM

AE CAN DO



of one hour at 1⅞ inches per second tape speed. Frequency response is flat within plus or minus 3 db from 100 to 5000 cps, with negligible flutter and wow, and signal-to-noise ratio better than 30 db.

• • •

A comprehensive plant location study designed to spur additional growth of Minnesota's electronics and related science industries was released recently by Northwestern National Bank of Minneapolis.

The study presents a detailed analysis of the area's electronics and related science industries and the factors underlying their explosive growth. The report includes a complete directory of the 117 electronics and related science companies operating in Minnesota in October, 1960. It lists the location, products, markets, number of employees and annual sales of each company. Further information may be obtained from James George, Northwestern National Bank, Advertising Department, Minneapolis, Minnesota.

• • •

The State of Hawaii has prepared a brochure titled *Space Facility Capability*. The study demonstrates the potentials of Mauna Kea (Island of Hawaii) for space vehicle launching operations. It covers topography, socio-economic facts and other pertinent data relevant to the capability of the Island to support construction and operation of a space facility with its attendant industrial complex.

Copies of the brochure may be obtained from the State of Hawaii Department of Economic Development, 1124 Miller Street, Honolulu 13, Hawaii.

• • •

Frederick Research Corporation has prepared a brochure which discusses radio frequency interference problems, approaches to solutions and future requirements.

For further information contact L. M. Carrese, Frederick Research Corp., 2601 University Boulevard, West, Wheaton, Maryland.

• • •

The third edition of a directory of military agencies responsible for development of missile ground support equipment has been compiled by the Department of Defense and is for sale to the public by the Office of Technical Services, Business and Defense Services Administration, U.S. Department of Commerce.

The directory, divided into Army, Navy and Air Force sections, lists various components, then lists the agency and the name of the individual within the agency who has cognizance over the item. Compiled by the Office of the Director of Defense Research and Engineering, *Technical Resources Directory-Missile Ground Support Equipment No. 3*, contains 25 pages, sells for 75 cents and is dated November 1, 1960. The report is identified as PB 161535 (Rev. 1) and is available from the Office of Technical Services, U.S. Department of Commerce, Washington 25, D.C.

• • •

The following publications are available from the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C.

Supplement No. 3 *Handbook Preferred Circuits, Navy Aeronautical Electronic Equipment.* 100 pages. $0.55 dated April 1, 1960.

Revised *Official Class B Product List and Product Assignment Directory*—the publication issued by the Business and Defense Services Administration (BDSA), U.S. Department of Commerce and used by defense, atomic energy and space contractors and suppliers, in connection with defense work under the Defense Materials System, $0.75.

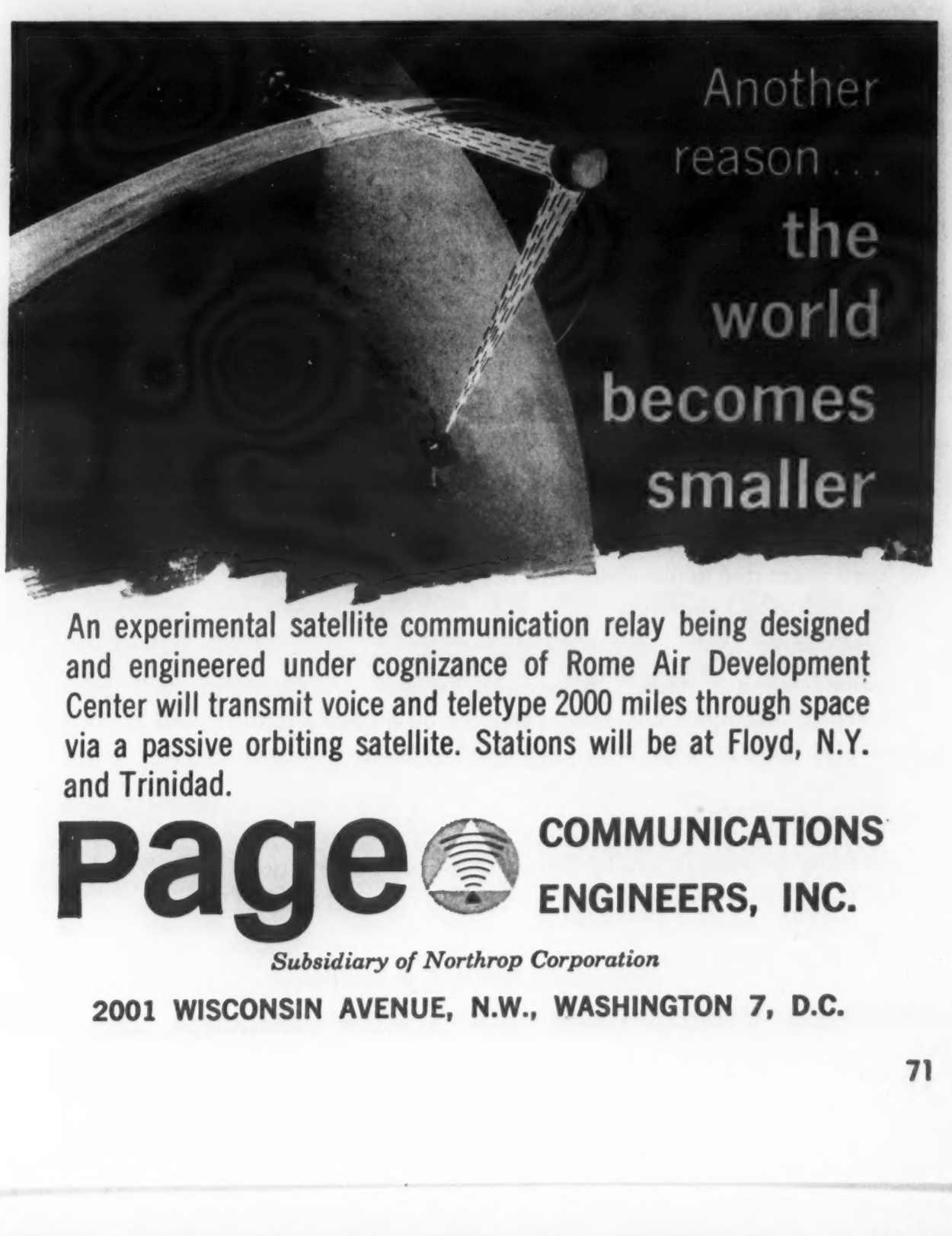
Electron Tubes and Semiconductors—Production, Consumption Trade, Selected Foreign Countries, $0.30. This survey constitutes the third and last report in a series prepared by the BDSA based on material from Foreign Service dispatches. The current report covers Australia, Canada, Japan, Netherlands, New Zealand, Spain, Taiwan, Turkey, Union of South Africa and West Germany.

Electronic Components, Production and Related Data, 1952-59, $0.20. This report is the first major study of the electronic components industries prepared by the BDSA and is part of a comprehensive over-all study of the electronics industries the Division is conducting.

• • •

Directory of Industrial Research Laboratories in New York State is a new guidebook published by the New York State Department of Commerce.

The publication lists more than 1,000 commercial and private research and testing laboratories, their special research fields, names of their

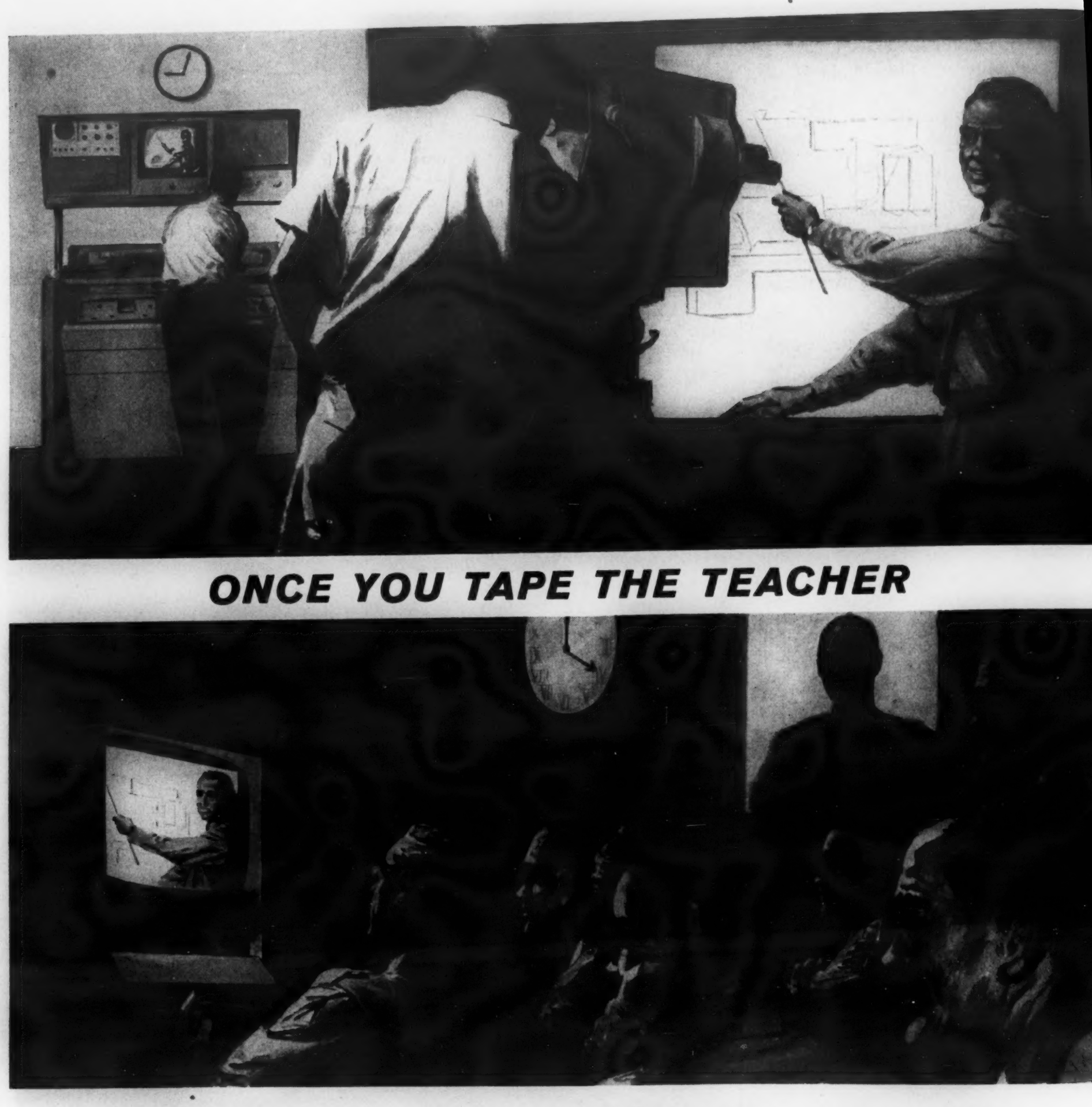


An experimental satellite communication relay being designed and engineered under cognizance of Rome Air Development Center will transmit voice and teletype 2000 miles through space via a passive orbiting satellite. Stations will be at Floyd, N.Y. and Trinidad.

Page COMMUNICATIONS ENGINEERS, INC.

Subsidiary of Northrop Corporation

2001 WISCONSIN AVENUE, N.W., WASHINGTON 7, D.C.



ONCE YOU TAPE THE TEACHER

HE'S AT HIS BEST ANYWHERE, ANYTIME

With an Ampex TV Tape Recorder preserving your best teaching efforts, you have a time-saving training tool that can be used wherever and whenever it's needed. Trainees learn faster due to more effective presentation and a more versatile visual method.

The *Videotape** Television Recorder has been saving valuable time in Armed Forces installations since 1957. A typical example: watching a taped closed-circuit telecast for three hours a day enabled a class in fundamental electronics to be graduated four weeks early.

Ampex VTR brings to military training these specific benefits: universal availability of top-level instruction (the best teachers can perfect their techniques before presentation) . . . increased trainee attention and concentration . . . close-up examination of elements by the whole class simultaneously . . . remote demonstration of dangerous phenomena. And VTR's inherent capabilities permit flexibility in editing plus maximum security since the tape can be immediately erased and requires no outside servicing.

Other Ampex VTR applications include: surveillance • weather briefing • flight training • missile recording • military medicine • tactical observation

*For complete information about the ways **Videotape** Recording can perform invaluable government service, write Ampex.*

AMPEX

*TM AMPEX CORP

AMPEX PROFESSIONAL PRODUCTS COMPANY • 934 Charter Street • Redwood City • California • Ampex of Canada Ltd., Rexdale, Ontar

executives and the number of scientists and engineers they employ. Copies may be obtained by writing the New York State Department of Commerce, 112 State Street, Albany 7, N. Y., or from the Department's regional offices located throughout the State.

• • •

The 25th edition of *The Radio-Electronic MASTER* is presently available at electronic parts distributors. Standard radio, TV, audio and electronic products sold through distributors are included in this issue. More than 175,000 items—with specifications and prices—are featured throughout its 1,600 pages. Over 12,000 illustrations are shown.

For rapid reference, the products of more than 330 manufacturers are organized into 32 product sections. A detailed index pinpoints the thousands of products displayed. The volume is published by United Catalog Publishers, Inc., 60 Madison Avenue, Hempstead, N.Y. A list of distributors offering the 1961 edition is available from the publisher.

• • •

A comprehensive *Telemetry Transducer Handbook* is being prepared by Radiation Incorporated for the U.S. Air Force. The handbook will serve as a reference volume in the field of transducers for telemetry systems employed in missiles, aerospace vehicles and sled tracks.

The book is expected to provide instrumentation engineers with information on availability, source and technical data on transducers for specific telemetry requirements.

• • •

McMillan Industrial Corporation, Brownville Avenue, Ipswich, Mass., has made available a report on the many elements of the design of "free space rooms" for testing of radar antennas. Included are charts for estimating room dimensions according to frequency and antenna size, a table of microwave absorber performance, a discussion of typical design problems and their solutions, a discussion of specification pitfalls, model specifications and a tear-out free space room questionnaire.

• • •

A booklet dedicated to the proposition that it pays to do business with U.S. electronic manufacturers is being distributed to industry by the Tube and Semiconductor Division of the Electronic Industries Association. The booklet was prepared in connection with EIA's campaign to counter electronic imports from low wage foreign producers which, in some cases have increased 240 times in the last five years for radio and television apparatus and parts.

Entitled *"Plus" Values*, the booklet highlights advantages of buying U.S. made tubes and semiconductors. The booklet will be distributed to electronics industry executives, government officials, purchasing agents, design engineers and distributors.

• • •

Phototubes in Industry has been released by CBS Electronics. The bulletin describes high-vacuum as well as gas phototubes, photomultiplier tubes, photocells and photoresistive cells. Typical applications are shown for photoresistive cells combined with transistors. The effects of temperature, excessive illumination and other environmental conditions are described.

Bulletin PA 220 is available through distributors of CBS tubes and semi-conductors, or from CBS Electronics, Information Services, 100 Endicott Street, Danvers, Massachusetts.

RCA

The Most Trusted Name in Electronics

For that IRE ®

NEW IDEA

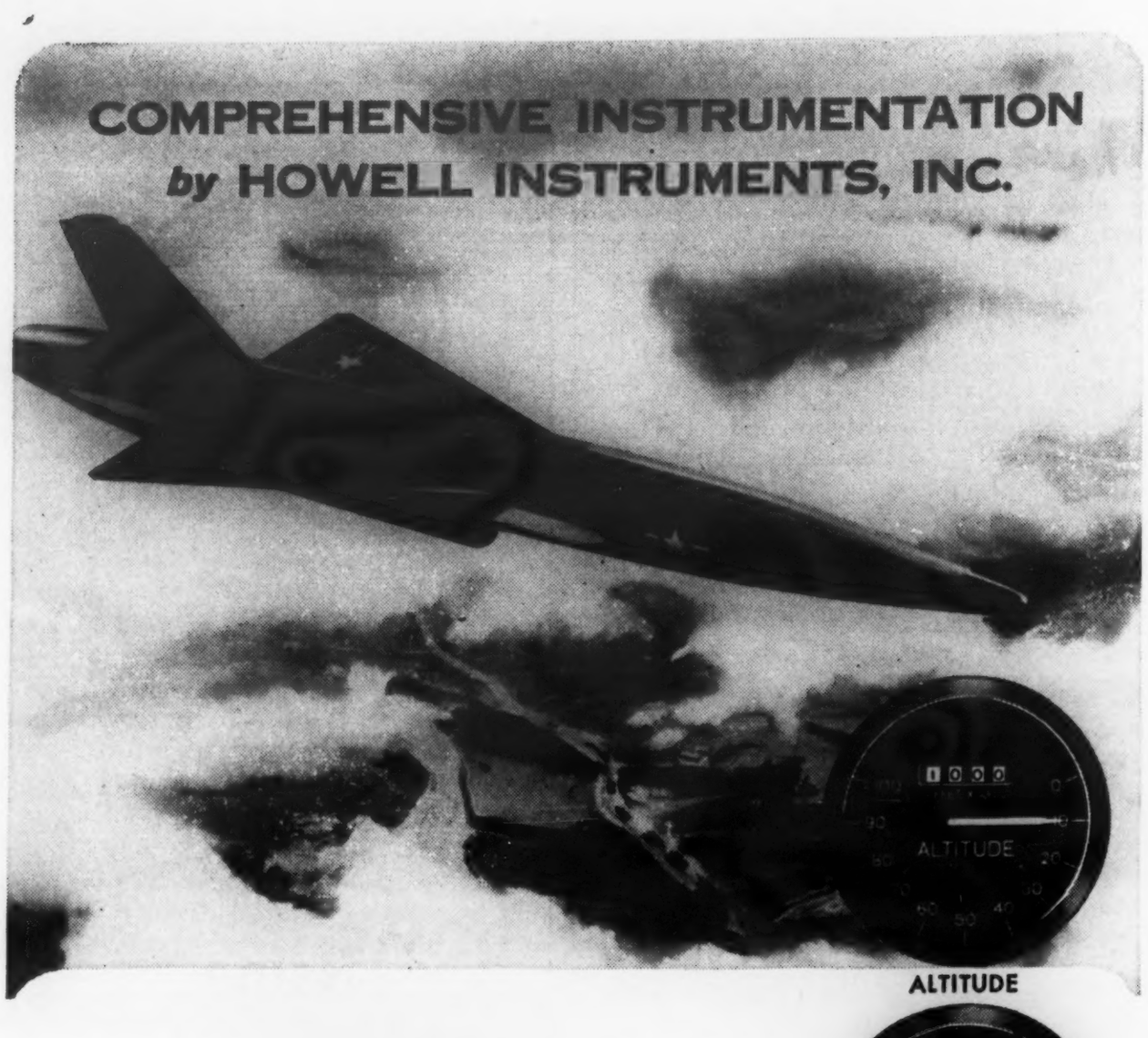
visit the

IRE SHOW

March 20-23, 1961 New York

Coliseum and Waldorf-Astoria Hotel

Members $1.00, Non-members $3.00 Age limit—over 18



AutoTemp

for the U. S. Army Signal Corps'
SWALLOW AN/USD-4 Surveillance Drone System
produced by REPUBLIC AVIATION CORPORATION
Missile System Division

The basic BH183 AUTOTEMP[tm] is matched to the curves of a variety of transducers to measure the various phenomena occurring in the test models of the Republic SD-4 SWALLOW. Each BH183-series 3″-diameter instrument is completely self-contained (miniaturized, silicon transistorized, servo-driven, hermetically sealed) with Zener reference, power supply, amplifier, servo motor, cold junction compensation as needed and the 144-inch slidewire and punched tape to linearize e.m.f. for exact, counter-type digital readout. Needle pointers are provided for quick reference. Accuracies are within 0.1%.

AUTOTEMP[tm] —The Instrument with the TAPE-SLIDEWIRE—is produced by the makers of the JETCAL® Analyzer, the only jet engine tester used throughout the world!

Full information is available for the asking!

Sales-Engineering Offices:
ATLANTA, GA., COMPTON, CAL., DAYTON, OHIO, VALLEY STREAM, L. I., N.Y., WICHITA, KAN., TORONTO, ONT. *(George Kelk Ltd.)*
MITCHAM, SURREY, ENGLAND *(Bryans Aeroquipment Ltd.)*

HOWELL INSTRUMENTS, INC.
FORMERLY B&H INSTRUMENT CO., INC.
3479 WEST VICKERY BLVD. • FORT WORTH 7, TEXAS

Photoprogress

Three manufacturers of equipme for the production of motion pi tures have announced plans to joint conduct a series of symposiums be held throughout the country th year.

Latest equipment available is be introduced and solutions to majo and minor problems confronting m tion picture photography users wi be discussed by Arriflex Corporatio of America of New York City Natural Lighting Corporation of Bu bank, California and Magnasyn Corporation of N. Hollywood, Cal fornia.

Open to all industrial, commercia and private motion picture producers the first show is slated for Kansa City, February 14th to 16th, at th Prom Motor Hotel. Subsequent ses sions will be held in Dallas, Texas February 20th and 21st and in Sant April 1st. Other cities tentativel scheduled throughout the year ar Salt Lake City, San Francisco an Seattle.

• • •

The Society of Motion Picture an Television Engineers presently has si proposed standards on 8mm magnet ic sound in early stages of considera tion. The Society's Sound Committe and the SMPTE 16 and 8mm Com mittee are considering the propose standards upon recommendation of special Ad Hoc Committee.

SMPTE Standards and Recom mended Practices must be approve by the sponsoring committee, th standards committee and publishe in the Society's Journal for thre consecutive months before they ma be submitted to the American Stand ards Association for approval.

Recommendations under consid eration are: 8mm Flutter Test Film Magnetic Type, which specifies 3000 cps magnetic sound test fil for use in determining the presenc of flutters in 8mm sound reproduc tion; 8mm Azimuth Test Film, Mag netic Type, which specifies a tes film having a magnetic sound recor to be used for aligning the azimut of magnetic heads on 8mm magneti recording and reproducing equip ment; 8mm 400-Cycle Signal Leve Test Film, Magnetic Type, whic specifies a 400-cycle signal level tes film for use in controlling magneti sound recording levels and standard izing methods of signal-to-nois

ALDEN SCANNERS MARK NEW ERA IN FACSIMILE COMMUNICATIONS

Compact, mobile Alden Flat Copy Scanners are in use today throughout the U. S. Weather Bureau Hi-Altitude Facsimile Network — marking a bright new era of simplified, continuous facsimile communication. And here are the reasons why —

NEW INSTALLATION SIMPLICITY . . . within two hours of air delivery, Alden Scanners at the Hi-Altitude Network were uncrated from their fold-away shipping cases, rolled in, plugged in, and *fully tested* for 60, 90, and 120 RPM quiet and dependable operation.

NEW COPY HANDLING SIMPLICITY . . . map transmission is no longer dependent on exact drum mounting. With Alden's expandable copy feed head, maps of *any width or length* can be scanned, one after the other, fed straight or crooked, *with only one Alden Scanner.* Original plotted maps can now be scanned without cutting to size. Map plotters have originals returned in half the time. Space and maintenance problems are minimized.

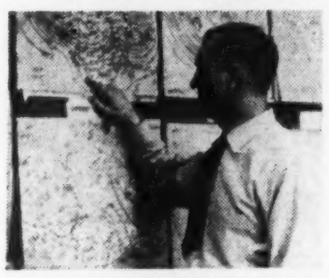
NEW CLARITY — NEW SHARPNESS . . . with copy feed rolls precisely positioning surface of the map on the flat copy scanner table, exact focal lengths are maintained for clear, sharp recordings. Focus smudge caused by unusually thick copy or copy lifting from drum is *completely eliminated.*

MEETS ALL FUTURE REQUIREMENTS . . . the practical scanning equipment for a world-wide facsimile map network. Speeds can be easily increased — without reengineering of equipment — for use with coaxial or microwave transmission facilities and computer-processed weather data.

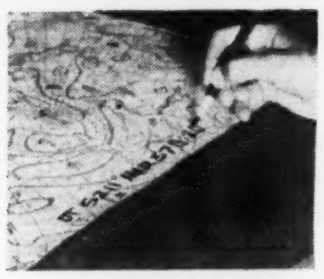
WHAT ARE YOUR FACSIMILE REQUIREMENTS? LET'S GET TOGETHER . . . Alden Flat Copy Scanners and Recorders are available in all sizes (and up to 30 times present network speed) to users and qualified manufacturers. Your inquiry is invited.

HERE'S WHY FORECASTERS PREFER* ALDEN RECORDERS AND ALFAX MAPS AND WHY WE THINK YOU'LL LIKE THEM TOO!

MOST COMMENDED FEATURES OF ALFAX MAPS



Color Is Easiest To Read Under All Lighting Conditions



Ease Of Writing And Erasing Enhances Analysis

Clean Crisp Duplicates By Bruning Or Ozalid

PLUS THESE UNIQUE FEATURES

LOW COST . . . Alfax papers save ⅓ to ⅔ yearly paper costs.

CLEAN . . . Electricity is the Ink . . . ion deposits make crisp brown marks on clean white background — free from dust, smudge and chemical irritants.

PERMANENCE . . . Alfax stores indefinitely . . . recording marks are permanent.

*In surveys of weather forecasters experienced with all weather facsimile systems, 3 out of 4 indicated a marked preference for Alden Recorders and Alfax Maps.

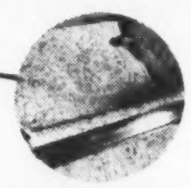
MOST COMMENDED FEATURES OF ALDEN RECORDERS

EASE OF INSTALLATION
Compact, mobile, and ready for immediate operation.

Uncrate

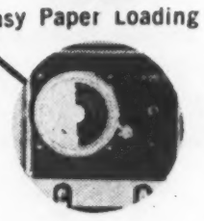
Roll in

EASE OF OPERATION
A new high in clean, quiet, trouble-free operation



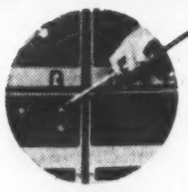
Instant Visibility

Easy Paper Loading



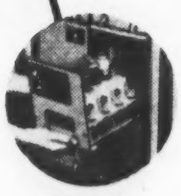
Automatic Time-Clock Programming

EASE OF MAINTENANCE



Front panel checks

Back connector checks



Plug-in construction

PLUS THESE UNIQUE FEATURES

SECURITY . . . Low voltage marking process does not generate a signal that can be intercepted.

HIGH SPEEDS . . . Sixty, 90 or 120 RPM operation — recorder technique and paper capable of 15 times these existing speeds.

VOLUME PRODUCTION . . . Designed for volume production on short lead time through unique expandable manufacturing processes.

CEILOMETER BREAKTHROUGH

Used with rotating beam ceilometer, Alfax paper and Alden recording techniques replace continuous live scope observation with a continuous pictorial history of cloud conditions. Dynamic tone-shade gradients in warm color reveal all pertinent ceiling information in easy-to-read, easy-to-interpret form. Superimposed dark maximum signal marking shows exact reportable cloud height.

ALDEN ELECTRONIC AND IMPULSE RECORDING EQUIPMENT CO., INC.
Westboro, Mass.
Alden Research Center

measurements on 8mm magnetic sound systems; Magnetic Sound Record on 8mm Motion-Picture Film, which specifies the lateral location and dimensions of the magnetic sound record on 8mm film; 8mm Multifrequency Test Film, Magnetic Type, which specifies a multifrequency magnetic sound test film for use in standardizing the replay chain for 8mm magnetic sound film, and, Magnetic Striping of 16mm Motion-Picture Film, Perforated 8mm 2R-1500, which specifies the location and dimensions of the magnetic striping materials applied to 16mm motion-picture film with two rows of 8mm perforations.

Names in the News

Maj. Gen. Raymond C. Maude, USAF (Ret.), has been appointed director of field operations for Philco Corporation's Government and Industrial Group.

John L. Herre has been appointed government sales manager, Semiconductor Division, General Instrument Corporation.

Paul E. Brandt has been appointed manager of Stromberg-Carlson's district office in Red Bank, N. J.

Charles B. Raybuck has been named vice president for Contract Management of Melpar, Inc.

Raymond Minichiello has been appointed manager of mobile communications product planning for General Electric's Communications Products Department in Lynchburg, Virginia.

Charles L. Spencer has been appointed special engineering advisor for Systems Evaluation of the Developmental Engineering Corporation (DECO).

Charles F. Thomas has been appointed to the newly created post of manager of Marketing and Planning for the Radio Corporation of America's Major Defense Systems organization.

Clifford A. Busse has been appointed to the position of vice president of Operations of The Siegler Corporation's Hallamore Electronics Division at Anaheim, California.

Alwyn L. Carty, Jr. has been named manager of Customer Relations, Military Products Division. Adler Electronics, Inc., New Rochelle, N. Y.

Dr. John L. McLucas has been elected to the board of directors of Astro-Science Corporation, Los Angeles.

Lloyd V. Berkner, president of Associated Universities, Inc., has been elected president for 1961 of the Institute of Radio Engineers.

Willis M. Hawkins was appointed a vice president of Lockheed Aircraft Corp.

Dr. Wilbur B. Davenport, Jr. has been appointed chief staff scientist at the Boston division of Developmental Engineering Corp.

Thomas Meloy has been elected chairman of the board of Melpar, Inc.

Edward M. Bostwick has been elected president and chief executive officer of Melpar.

Henry M. DeRosa has been appointed vice president in charge of marketing for Vector Manufacturing Co.

Dr. Theodore von Karmam has been awarded the Robert H. Goddard Memorial Award.

Lt. Col. Bascom E. Tillotson, Jr. has been awarded the Air Force Commendation Medal for outstanding work on the organization and management of Air Force communications field activities.

Henry Williams, Jr., USN, (Ret.), has been appointed resident manager of the Washington, D. C. office of Middle West Service Company.

Lt. Col. Richard Dowell has been assigned as chief, Office of Technical Liaison, OCSigO.

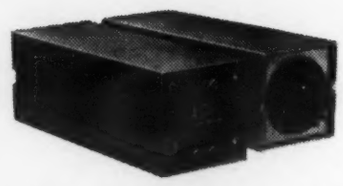
GET ON THE ALTEC LINE—for improved communication equipment

Copyright 1961 Altec Lansing Corporation

For performance, reliability, and servicing ease, the Altec line of amplifiers and equipment have won a resounding vote of confidence from the industry. Precision-engineered to meet your most exacting specifications, Altec products offer the improved design that makes maximum use of minimum space — and the "plus" that makes the difference — Altec quality.

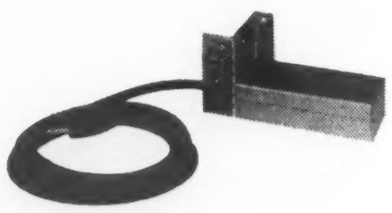
ALTEC "Quick-Fix Termination Bay

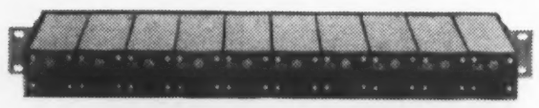
Typical cable termination bay has capacity for 50 transmitting and 50 receiving channels. Equipped with ALTEC plug-in line repeat coils, transistorized plug-in repeater amplifiers, plug-in equalizers.



The 455A Amplifier is a transistorized repeater type amplifier wrapping up a compact package of gain for telephone circuit use. Incorporates the gain, power handling capacity, frequency response, plug-in features in the physical size of vacuum tube type repeater. Ten repeaters go in the same standard rack mount used for vacuum tube types. Operates on 48 volt DC @ 22 ma: (453A model operates on 24 volt DC). Since it is transistorized no 130 volt supply is needed. For details, write for Altec Lansing Bulletin #AL-1600.

The 533 Power Supply is designed to fit within a 105-B Apparatus Box. The power supply bracket includes the required socket and space to mount a single ALTEC transistorized repeater type 449, 450 or 453-A and, at reduced power, the 447-A. Operating from 117 volts AC the unit delivers 20 v at 25 ma. Write for Bulletin #AL-1600.





The 12910 panel is provided to mount 10 amplifiers or Altec line Equalizers. The panel is 1¾" in height.

For complete information about Altec telephone and paging equipment, write to the address below or call 714- PRospect 4-2900 in Anaheim.

ALTEC LANSING CORPORATION

ALTEC LANSING CORPORATION, DEPT. S-2-T
1515 S. Manchester Ave., Anaheim, Calif.
161 6th Ave., New York 13, N. Y.
A subsidiary of Ling-Temco Electronics, Inc.

THIS TROUBLE HAS NO FUTURE!

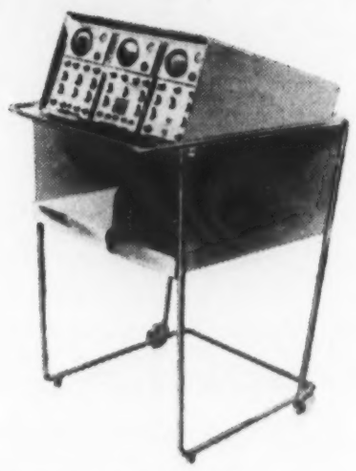
Radiation's TDMS anticipates circuit failure in telegraph and data transmission links without interrupting traffic

Radiation's Telegraph Distortion Monitoring System—TDMS—is a compact, self-contained unit for continuous on-line monitoring, testing and analysis of telegraph and data transmission links.

Its sensitivity to signal distortion is so acute that it can locate and describe equipment misalignment *before* it becomes an operational problem.

TDMS does its job without interrupting traffic and in a language that is easily interpreted by a nontechnical operator. Thus, in our illustration above, a line that is becoming increasingly capacitative can be located and rectified prior to circuit failure.

For detailed information on the TDMS, write Dept. S-2, Products Division, Radiation Inc., Melbourne, Florida. Refer to Bulletin RAD-E-100B.



TDMS performs all of these *on-line* functions: 1. Distortion transmitter; 2. Test message transmitter; 3 Distortion analyzer; and 4. Linear wave-form analyzer.

Among available accessories are utility cart (shown above), portable power supply, and relay-test adapter.

RADIATION
INCORPORATED

A complete tape handling station

–in just 2 square feet of space

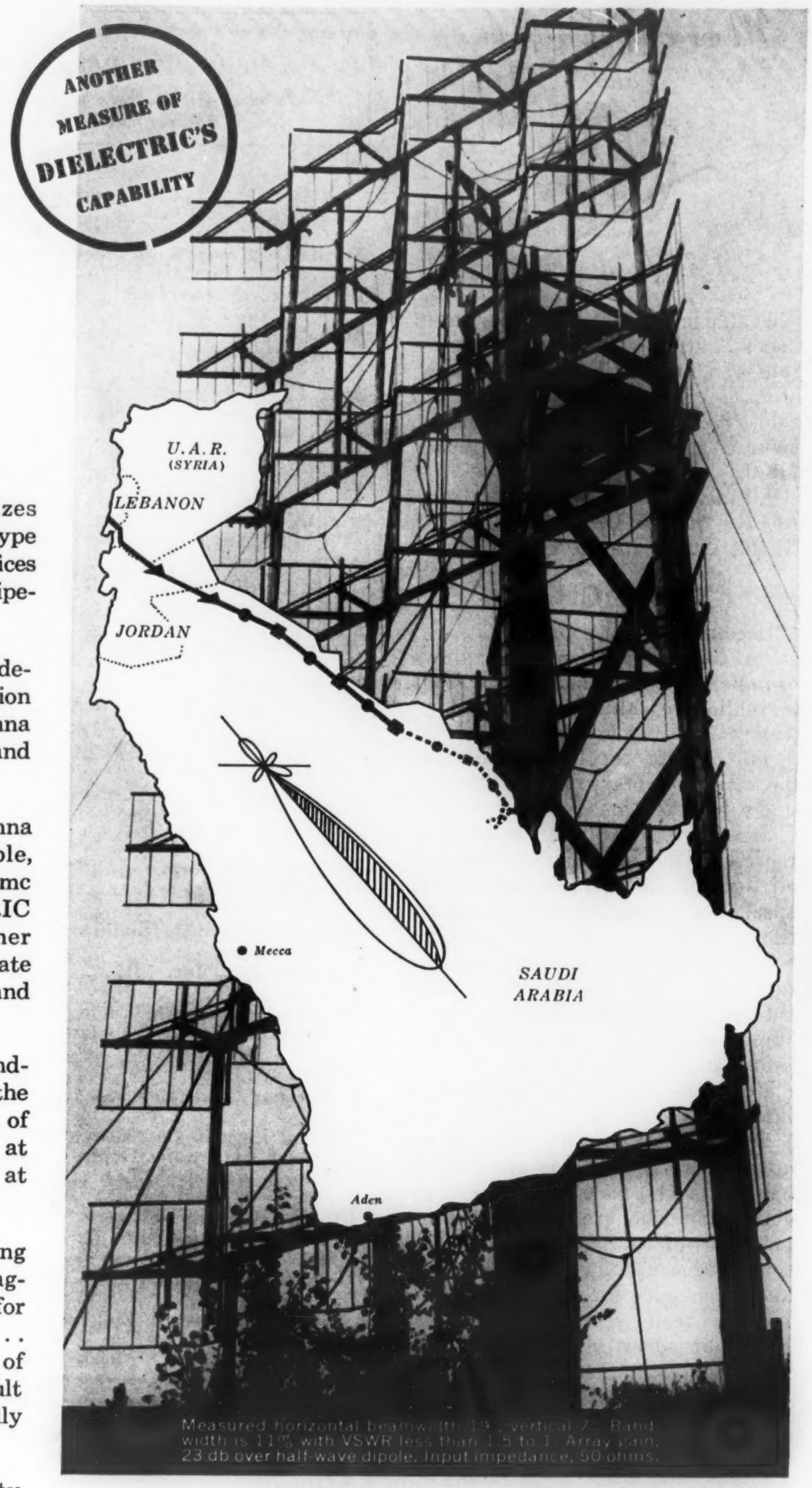
A tape transmitter, typing reperforator and keyboard transmitter—all in a single compact unit! Besides sending and receiving messages in perforated tape form, this Kleinschmidt unit also provides for tape preparation, editing, reproduction and direct line keyboard or tape transmission. Kleinschmidt's complete line of fine equipment, switching centers and systems are in U.S. Military use throughout the world. *Call now to arrange for a discussion with our systems and equipment engineers.*

Send-receive
Page Teleprinter

SCM KLEINSCHMIDT
DIVISION OF SMITH-CORONA MARCHANT INC.

Lake-Cook Road, Deerfield, Illinois · Telephone Windsor 5-1000

CONTROLLING TRANS ARABIAN'S PIPELINE VIA HIGH DIRECTIVITY VHF ARRAYS


ANOTHER MEASURE OF DIELECTRIC'S CAPABILITY
U.A.R. (SYRIA)
LEBANON
JORDAN
Mecca
SAUDI ARABIA
Aden
Measured horizontal beamwidth 19°, vertical 7°. Band width is 11% with VSWR less than 1.5 to 1. Array gain, 23 db over half-wave dipole. Input impedance, 50 ohms.

Trans-Arabian Pipeline Company utilizes point-to-point multi-channel voice, teletype and mobile communications between its offices in Beirut, Lebanon and units along its pipeline from Saudi Arabia.

DIELECTRIC'S ASSIGNMENT: — to design and develop, for a substantial extension of this system, high directivity VHF antenna arrays for multi-channel communications and automated pipeline control.

To meet the requirement for an antenna system that would provide dependable, over-the-horizon communications at 160 mc . . . power, 250 watts . . . DIELECTRIC built five arrays (each with 32 corner reflectors), and complete with "corporate structure" feed system plus supporting and mounting hardware.

Also required was a network of coaxial band-pass filters for duplexing, tunable over the useful frequency range of the antenna. All of the elements had to be carefully adjusted at the factory and ready for installation at the site.

The design, development and complete testing of these arrays — plus disassembly, packaging and shipment to the site . . . ready for installation with minimum adjustments . . . in record time . . . is a significant measure of DIELECTRIC'S capability to solve difficult problems in communications, resourcefully and dependably.

If you'd like to put such high-level capability to work on your communications problems, talk to DIELECTRIC. Capabilities, facilities and accomplishments are described in our brochure. Write for it today.

Other areas of **DIELECTRIC** capability in coaxial, waveguide and open wire techniques . . .

TRANSMISSION LINE & COMPONENTS • NETWORKS • SWITCHES
TEST EQUIPMENT • R&D ENGINEERING

dial DIELECTRIC for solutions to communications problems.

DIELECTRIC PRODUCTS ENGINEERING CO., INC.

RAYMOND, MAINE

Membership Certificates and

AFCEA Insignia

Available for immediate purchase: Lapel button for civilian dress, gold—$5.00. AFCEA official medal, bronze—$3.00, silver—$4.00 and gold—$5.00. 3" dia. decalcomania, 4 for $1.00. Membership certificate, $1.50.

All insignia may be ordered from: AFCEA Service Dept., 1624 Eye St., N. W., Washington 6, D. C.

Why SIGNAL?

Here are several good reasons why an AFCEA-SIGNAL membership is of importance to you. It affords chapter affiliation with friends in the electronics field. It creates a very congenial climate for the members of the civilian-military team to discuss and solve problems of mutual interest.

Secondly, the AFCEA organization represents industry, government and all the military services and SIGNAL speaks for the experts in communications, electronics and photography. SIGNAL Magazine is a continuing contact with the professions of communications, electronics and photography. It provides its readers with the best information on timely subjects and major developments of professional interest.

Thirdly, SIGNAL is important to our advertisers. SIGNAL ads are read by executives who have the power of decision and who are alert to the importance of strengthening our national security in communications and electronics through the civilian-military team relationship. SIGNAL gives our advertisers a crystal clear shot to present facts about services, products and achievements to a specialized and interested audience.

Fourthly, the AFCEA Convention guarantees a highly intellectual and top side audience to hear presentations of technical papers on the latest in technical achievements and trends of the future. Members, guests and friends are given an opportunity to view first hand an entire display of products and/or services in an atmosphere of a masterfully coordinated technical trade show.

SIGNAL's monthly magazine—12 important issues—makes the difference, when you want to know the facts of life in this electronic age.

National Advertising Representatives

William C. Copp & Associates

72 West 45th St., New York 36, N. Y. MUrray Hill 2-6606

35 E. Wacker Dr., Chicago 1, Ill. FInancial 6-8242

INDEX TO ADVERTISERS

Alden Electronic & Impulse Recording Equipment Co., Inc. *Molesworth Associates* 75

Alpha Corp. *Don L. Baxter, Inc.* 32, 33

Altec Lansing Corp. *Davis, Johnson, Andersen & Colombatto, Inc.* 61, 76

American Telephone & Telegraph Co. *N. W. Ayer & Son, Inc.* 5

Ampex Corp. *Boland Associates* 72

Automatic Electric Co. *Kudner Agency, Inc.* 70

Burroughs Corp. *Campbell-Ewald Co.* 23

Chicago Aerial Industries *Leonard Primer Adv.* 19

Collins Radio Co. *Tracy-Locke Co., Inc.* 4

Comptometer Corp. *Frank C. Nahser, Inc.* 65

Dielectric Products Engineering Co., Inc. *Grant Adv., Inc.* 79

Electronic Communications, Inc. *Alfred L. Lino & Associates*..... 34

F X R, Inc. *Beecher Associates* 68

General Electric Co., Heavy Military Electronics Dept. *George R. Nelson, Inc.* 16, 17

Granger Associates *West Associates* 1

Hallicrafters Co., Military Electronics Div. *Henry B. Kreer & Co., Inc.*..... 63

Hoffman Electronics Corp. *Honig-Cooper & Harrington, Inc.* 9

Howell Instruments, Inc. *Kotula Co.* 74

Hunter Manufacturing Co. *Meerman's, Inc.* 13

Industrial Transmitters & Antennas, Inc. *Neville & Ronald Inc.* 29

Institute of Radio Engineers *Raymond Schoonover Adv.* 2, 46, 67, 73

Kahn Research Laboratories, Inc. *Snow and Depew, Inc.* 42

Kleinschmidt Div., Smith-Corona-Marchant, Inc. *Alex T. Franz, Inc.* 78

Mech-Tronics Corp. *Hollander, Weghorn, Morrow*.. 64

Page Communications Engineers, Inc. *S. G. Stackig, Inc.* 67, 69, 71

Philco Corp., Government & Industrial Group *Maxwell Associates, Inc.* 44

Philco Corp., Lansdale Div. *Maxwell Associates, Inc*....2nd Cover

Radiation, Inc. *G. M. Basford Co.* 77

Radio Corporation of America *J. Walter Thompson Co.* 73

Stromberg-Carlson Co. *D'Arcy Adv. Co.* .....4th Cover

Teletype Corp. *Marsteller, Rickard, Gebhardt & Reed, Inc.* 49

Westrex Corp. *Compton Adv., Inc.* .....3rd Cover

Wilcox Electric Co., Inc. *Valentine-Radford Adv.* 30

APPLICATION FOR INDIVIDUAL MEMBERSHIP

ARMED FORCES COMMUNICATIONS AND ELECTRONICS ASSOCIATION
1624 Eye Street, N. W. Washington 6, D. C.

NAME: _____
(Last Name) (First Name) (Middle Name or Initial)

Address _____

_____

Firm or Military Installation: _____

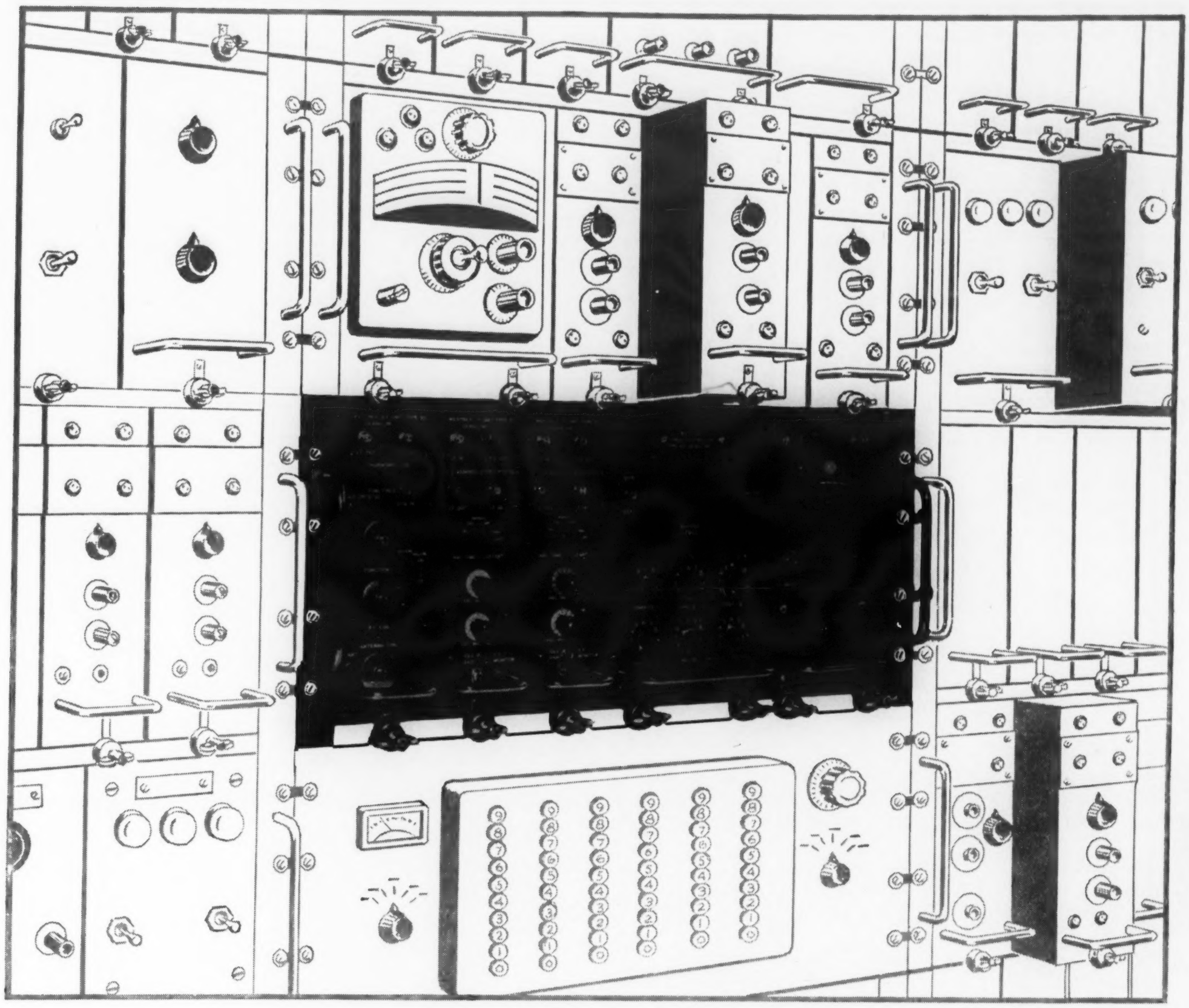
Title: _____ Type of Work: _____

U. S. Citizen ☐ or Citizen of _____ Ham Radio Call _____

Full—$5.00 ☐ Subscription-Non-Member—$7.00 ☐ Foreign Mailing—$8.00 ☐

Enclosed find $_____ for annual dues for AFCEA membership (or subscription) which includes the monthly magazine SIGNAL and Chapter Affiliation.

DATE: _____ SIGNATURE: _____



New HF SSB Receiver heart of a whole new "state of the art"

New flexibility. Building block modules make the Westrex 600 receiving system the most versatile communications receiver. The RF, IF, AFC, synthesizer, test and power supply modules can be arranged in any manner dictated by user requirements. As an example, a typical 4-voice channel SSB circuit can be established using one RF and four IF modules. As many RF channels as required can be accommodated using fixed frequency or continuously tunable RF modules. Operation can be either "local" or "remote."

New high performance. Significant features are:

- Extremely low third-order distortion (85-90 db) is made possible by a breakthrough in receiver front-end design.
- The sensitivity is very high. Image and IF spurious rejection is excellent. The AGC is extremely flat over a range of 130 db.
- The SSB filters have exceptionally high performance with very low pass-band phase distortion and very steep selectivity skirts.
- Cast aluminum housings are used for the RF, IF, and synthesizer modules, keeping radiation to a fraction of common receiver values.

Learn more about this significant receiver development. Write or phone today.

Westrex Corporation

A DIVISION OF LITTON INDUSTRIES

Communications Equipment Department, Section 163

540 W. 58th St., New York 19, N. Y. 1625 I St., N.W., Wash. 6, D. C.

Core concept: brainpow

Systems programs are processed at Stromberg-Carlson with the smooth efficiency of a computer in action. Everything is ready in advance. The top scientific, engineering and management people are all assembled. The prime capability subcontractors are poised to go. Your project is under way in the time previously needed just to gather the group. *This is Stromberg-Carlson's Core Concept of Systems Management.*

Equally important, the permanent nature of the group has allowed us to bring in men of exceptional abilities—men who can actually handle major projects simultaneously or successively. And behind

the
co
sp
Co
na
rig
Le
ca
En
ar

STROMBERG-CAR
A DIVISION OF GENERA
1400 N. GOODMAN STREET /

ower at the ready—*now*

them stands Stromberg-Carlson's experience in communications, computers, data transmission, processing and display, and high-speed teleprinters.

Core Concept is speeding development of a key passive reconnaissance system—among several Very Important Projects—right now.

Let our Systems Management people show you how Core Concept can serve as *your* supermarket for systems, ideas and talents—now.

Engineers and scientists interested in challenging opportunities are invited to send résumés to Director, Technical Employment.

CARLSON
RAL DYNAMICS
EET / ROCHESTER 3, N.Y.